FROM THE PUBLISHERS OF AMATEUR TELEVISION MAGAZINE™

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT AMATEUR TELEVISION *

* but were afraid to ask

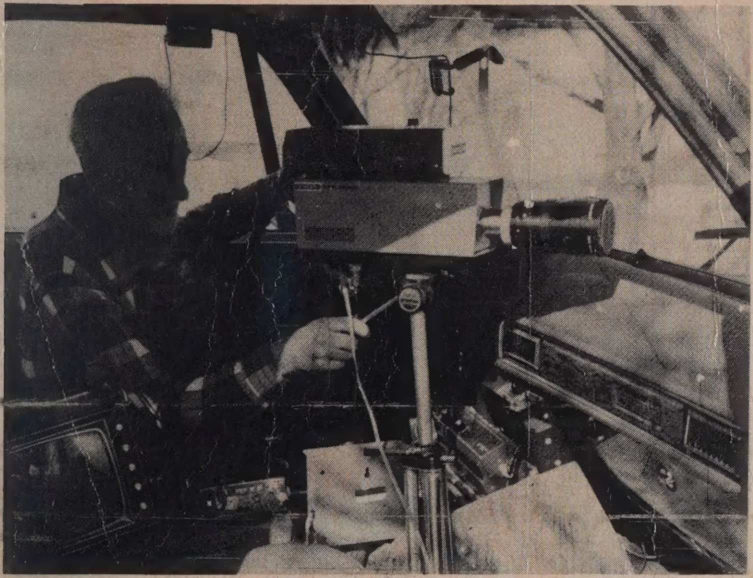
REVISED 3RD EDITION

$9.95

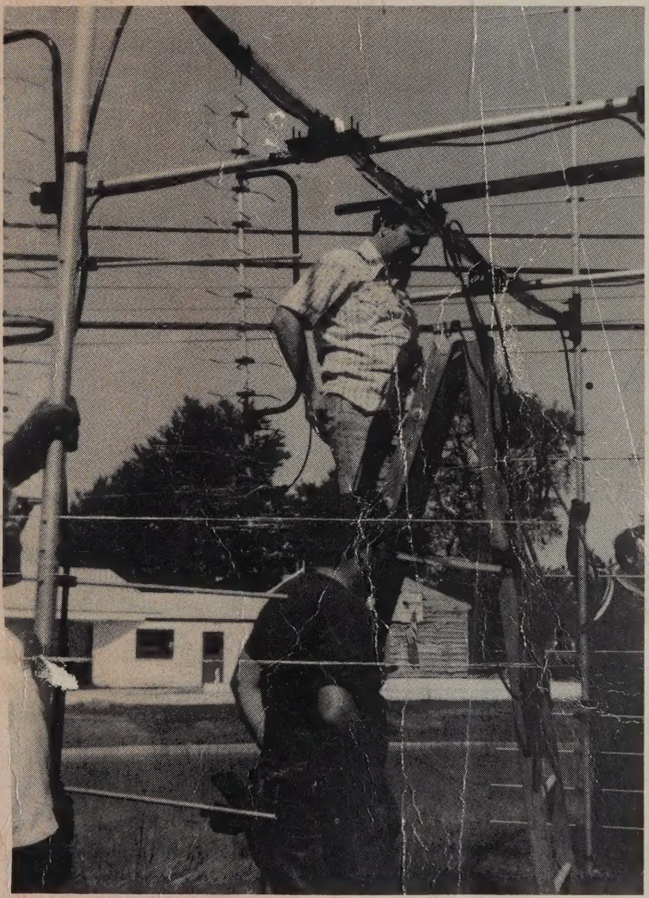
A5BS #100

A COMPLETE GUIDE TO SETTING UP YOUR OWN AMATEUR RADIO TELEVISION STATION

FAST SCAN TELEVISION



SLOW SCAN TELEVISION



History * What Equipment You Need * Deale Directory * Video Theory * Cameras * Recorders Lighting Techniques * Special Effects * T.V Studio * Sound With ATV * ATV DXing * Mobil FSTV * Building Projects * Filters Downconverters * Exciters * Linears * Vide ID'ers * Test Equipment * Test Pattern * Signa Reporting Chart * ATV Repeaters * ATV Groups Special SSTV Section * Cumulative Index Of Ove 1300 Articles On ATV * Dealer Advertising

EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT ATV*

but were afraid to ask

REVISED 3RD EDITION

by Mike Stone WB0QCD
Editor and Publisher of A5 MAGAZINE

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ATV IN A NUTSHELL
Permission Granted for updated 2nd Edition

"This book is dedicated to ATV'ers all over the world who have bravely taken on the challenge of Amateur Television and proving that it can be done-for these are the "true pioneers" in the spirit of Ham Radio; also to my parents Paul and Ellouise Stone, upon their retirement, whom encouraged my interest in Shortwave Radio during my early years; and to my wife Rosemarie and children Jeff and Wendy for allowing another segment of Amateur Radio into the "shack."

—M. Stone WB0QCD

We gratefully acknowledge the following individuals for their generous contributions to this manual:

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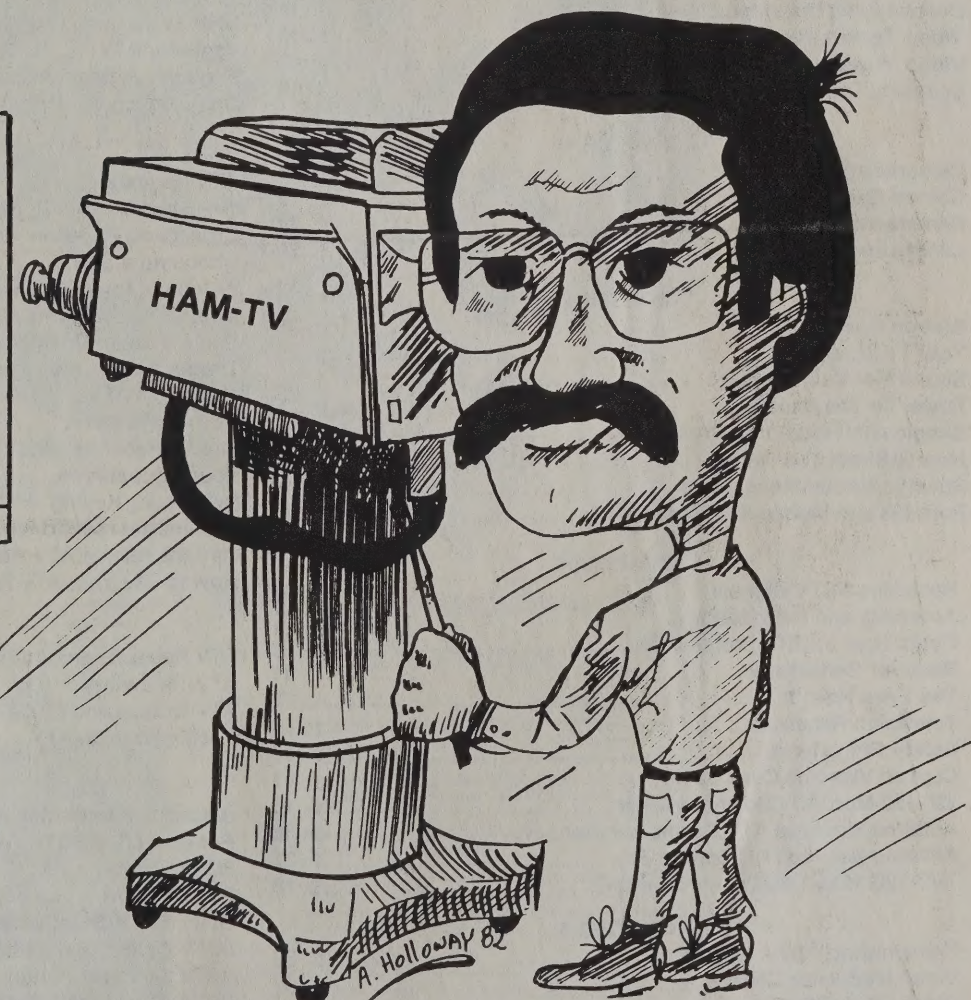

Photos by Mike Stone and Henry Ruh except as noted.
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Most Diagrams by Contributing Authors

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FOREWORD

Never before, has a hobby like "Amateur Radio" brought out so many interesting modes of communications to operate. Amateur Television, be it Fast-Scan, Slow-Scan or somewhere in between, remains as one of the last true pioneering and experimental areas for the builder/operator. Hams invented TV, experimented with it years before what was to become the commercial TV industry that is so well known today. Even in the 1980's, further experimentation continues, especially in digital forms, at higher resolution, better color and sound methods and reduced bandwidths. "Give us those who have tired of non-specialized modes, who have keen interest in UHF and microwave applications and we will make them into ATV'ers!"

— WB0QCD

QST Magazine Ad in 1940's

CHAPTER 1

THE EVOLUTION OF TELEVISION

by Kenneth L. McIntosh
907 Radcliffe Road
Baltimore, MD 21204
(A5 Magazine Article March 1974 Vol. 4 No. 2)

When talking or writing about television, it seems more appropriate to say "Evolution" rather than discovery or invention. About 1900 in Newfoundland, Marconi, an experimenting inventor discovered a way to transfer signals through the air. His discovery provided a means of sending messages quite a distance without wires and was called "Wireless". These crude signals were soon changed to words and music, which was called "Radio."

Television was first just a light a mechanism added to radio. By using and expanding the circuits of radio, the peak voltages of soundwaves were amplified and wired so that ech turned the light our for an instant. The effect of lights going on and off had been produced earlier on Times Square in New York City. Anyone who watched the electric ads realized that lights and shadows form an image and by blinking create the illusion that the figures in the picture are moving. By using the same idea the early experimenters made a radio light go on and off at various locations. This made a silhouette type image which was the first picture transmitted by radio.

Sets that were made to receive these images were names "Radiovisers." The first models received the picture and that is all. If you wanted to hear sound, which was mainly to announce the picture, you needed another set. This development was called "Radiovision." Radio had listeners and radiovision had "lookers" as they were called in those days. People that had both sets received a complete program. Later both sets were combined with a switch to use them alternately. Of course, eventually the combined sets received sound and picture at the same time about the same as they do today. Pictures had been transmitted on telegraph and telephone wires, but this procedure never became popular. It was soon discontinued, and replaced by radiovision which was renamed "Television." Television continued to improve technically and increase in importance during the next 50 years.

THE FLYING SPOT

To transmit a picture by radio, it was first necessary to produce a white background. This background could be made of hundreds of little lights, any one of which could be darkened when needed. Instead of many lights, one light was used. It was viewed by looking through a tiny hole moving so fast that it looked like a streak. This illusion was first produced in 1884 by Paul Nipkow, a German, who made a small hole in a disc which passed over a lighted area. As a falling star looks like a streak across the sky the "flying spot" as it was called, looked like a streak across the lighted area where the picture was to be seen. As soon as the first spot had crossed the area, a second hole a little lower on the disc started across. To produce a lighted area about as big as a postage stamp, 24 to 60 holes were used. When the disc turned slowly across the lighted areas, the light looked like a moving spot. When the disc turned rapidly, the spot looked like a streak. When the disc spun slowly, the streaks seemed to follow each other - first across the top of the picture area - then one a little lower and so on to the bottom. When the disc spun rapidly, the streaks came so close together that the whole area seemed to be lighted. The whole lighted area could be seen through the disc at one time or that is the way it appeared to the viewer. Actually, all that was seen at one time was one tiny spot of light moving rapidly from right to left and from top to bottom. Later the tiny holes were replaced with small lens, which focused the light to create a more brilliant spot on the picture area.

The invention of the picture kinescope tube by Valdimir Zworykin in 1923 eventually brought a revolutionary change to the entire procedure. A strong electrical attraction was placed on the face of this tube. Electrons which were released by heat from the base of the tube flew to this attraction. There they struck a phosphorus coating and produced a bright spot at the point of impact. This spot was deflected slightly by placing four plates in the neck of the tube through which the electrons passed. Each plate had an attracting force that was constantly changing. One plate was on the left and pulled the electrons slightly to the left - one was on the right and pulled it to the right. At the same time one was on the top pulling it up and one was on the bottom pulling it down. By proper timing of the electrical charges on the plates, the "flying spot" was made to light the picture area on the face of thye tube in much the same manner as the scanning disc had done. Later the plates were replaced with induction coils on the outside of the tube. These produced a stronger attraction for the electron, a greater degree of deflection and made larger picture tubes possible.

THE BLINKING LIGHT

With the flying spot crossing the picture area from side to side and from top to bottom so rapidly that the whole space seemed to light up, it became necessary to have a light that could be turned on and off electrically in an instant, at any place in the picture area. No warm up time, no cooling off, no after glow could be tolerated. A neon or gas tube with a large square plate for faster action used behind the disc sets with spiral holes. Later, a tube with a small spot brilliantly lighted was usd with the lens type discs. This was called a crater tube. The first were about the size of a baseball but finally were reduced to the size of an automobile lamp bulb.

Later the use of the electron and a phosphorus coating inside the face of the picture tube eliminated the need for a separate light. But whichever system was used, the light source had to go on and off instantly at any location and produce a black dot at any point in the picture area.

A series of dots created a silhouette type picture. Still later by modifying the peak voltages in the sound waves a partial dimming of the light was possible. The fluctuating current modified the brightness in exact proportion to the light reflected on the image at the broadcasting station. This produced gray areas, shadows and permitted the showing of half tones for the first time. Eventually the use of three lights from three colors of phosphorus on the face of the picture tube - one red, one blue and one green-produced color pictures.

TOGETHERNESS

If togetherness is important anywhere, it certainly is in television. The senders equipment and the receivers equipment must do everything at exactly the same time. Close will not do - they must be exactly together. This might be easy if the sender and the receiver were in the same place, but usually they are miles apart. To overcome distance, electrical motors were used to operate the equipment. Clocks operating from the same electrical source keep exactly the same time because the motor speeds are regulated by the 60 cycle per second pulses alternating current produces. The pulses are ex-

actly the same only when the current comes from the same source. This worked very well for television in the same locality, but where the source was different from city to city one could be a fraction of a second behind or ahead of the other unless both generators were started at exactly the same instant. This seldom happened, so there had to be a means of speeding up or slowing down the motors until they were exactly together. Some models had ways to increase of decrease the amount of current by turning a knob on the set. Some used friction or cone shaped reducing pulleys to change the motor speed. Some used tuning forks to adjust the sets. These adjustments sometimes kept the viewer busy. What they needed was something that could be put into the radio wave that would affect the local set the same as the senders equipment. Eventually a series of peaks were developed that were received together with the signal that carried the program. Like the shrill whistle that only a dog can hear, these peaks affected the speed of the receiver, but never reached the listener's ears. Like a boy pushing two swings together in a playground, both at the same moment with exactly the same pressure, these peaks kept the equipment operating together. Keeping motors and moving parts exactly together is called "synchronization.'

THE SEARCH FOR SIZE

The first scanning disc sets with their tiny holes provided a picture are a scarcely an inch square. Viewing in those days was more of a peep show than anything else. Magnifying glasses were sometimes attached to the set to see this small image. First smaller ones and then quite large ones were used. Focusing the magnifying glass was a problem and sliding supports were used on some sets for that purpose. With the invention of the picture tube, greater deflection was possible and the image ranged from 3 to 7 and even ten inches by the late 40's and early 50's. Then the use of inductance coild provided 14, 17, and 19 inchmodels. This trend continued and eventually 30 inch picture tubes were produced. These were very heavy and before long picture tubes went back to 25 inches - the size that is popular today.

While the tubes were getting bigger, the body or chassis was getting smaller. Many different versions of this combination were trie. Some of the sets tapered from front towards the back. Plastic cases replaced wood to reduce size. Tin was then used to reduce the size still further. One company separated the picture tube from the body of the set and placed it on top. The floor model of this set was called the "Shaving mirror" because it was so big on top and had such a small slim body. It looked like mirrors men used for shaving in those days.

Several manufacturers tried projecting the image down into concave mirrors, which enlarged it and then projected it onto another mirror to put it right side up again. In one or two makes the second mirror reflected the picture onto an opaque glass screen about 18" square for viewing. Most of these sets looked like a massive piece of furniture which unfolded to expose the screen. The price of each was about $1,000 twenty five years ago, which is approximately the equivalent of $3,000 today. Some of these for use in taverns and auditoriums were seven feet tall. In fact several designers thought a television should look like a piece of furniture. They put doors on the front of the cabinet to hide the picture tube and control knobs. Until recently some manufacturers have combined television in console cabinets with radios and record players. In some models a tape deck is also included so you can have an input and record what you wish for later listening or viewing. For the sportsman or hunter who doesn't like the progran, there is a provision for injecting games he can play or targets at which he can shoot. This is called "Odyssey."

Every once in a while, size is forgotten and someone tries to make the smalles set they can. These produce 2½ to 4 inch pictures and use mostly transistors instead of tubes and batteries for power. They can rest on your stomach when you are lying down and were called tummy TV's. Although they are advertized as such there never has been a completely solid state all transistor TV. They all have one tube to create the picture. Maybe some day the picture tube will disappear the way the old scanning disc did and even the images and pictures will be produced without it.

RISE AND FALL OF THE AERIAL OR ANTENNA

Marconi, the man who discovered radio, was probably the first to realize the advantage of height to receive electric signals. He attached an aerial to a kite to get the wireless impulses he wanted. In the middle twenties, the usual aerial was a 50 foot wire stretched from the top of the roof to a tall tree or telephone pole. Later these were taken down and two adjustable rods called "rabbit ears" were set on top of the sets to receive the signals. Many makeshift things were tried. Some radios were even attached to bed springs for aerials. Some radio and television receivers had sliding panels in the top with a spiral coil of wire attached to them for an antenna. Even though they could be adjusted slightly, these panels did not work well. Single or double rabbit ears either separate or as a part of the set continued to be popular.

With the development of color sets the aerial or antenna usually was put up on top of the roof again. This time they were composed of parallel bars of various lengths to attract the different wave lengths on various channels.

When large metal surfaces are near a TV receiver, the signal or radio wave often arrives at the set twice - once direct from the broadcasting station and once reflected from the metal surface. This creates a double picture. The reflected image is called a ghost. The present trend is toward burying cables under ground to carry the programs to sets in the home. It is possible that this will eliminate ghosts and other interferences that are now experienced with the aerial or antenna no matter how high or low it is.

TRANSITION OF THE TV TUNER

The first television sets tuned the program in about the same as radio did. A small knob turned a dial with numbers from 55 to 160 on radios and those used with radiovisors went to 300 to receive 2950 Kc. This knob changed the resonate frequency of the antenna and selected the one that picked up the program that was desired. Some times it was difficult to get the dial right on the station and slight adjustments were necessary. These adjustments were called "tuning" and the circuits involved were called tuners. Later the tuner had thirteen individual circuits, each pre-tuned to an individual channel. One of the early sets had thirteen push buttons numbered from 1 to 13. The viewer pushed the button attached to the channel he or she wanted to see. This was similar to the way some car radios work today. The push buttons soon disappeared from TV receivers and a large knob was used to turn the tuner from one channel to another. With the increase in channels from 13 to 83, two tuners were necessary. One was for the low channels - 2 through 13. Channel 1 had been discontinued for television use. These were designated very high frequency channels. The other tuner was for channels 14 through 83 which were named ultra high frequency channels. Now we have sets with remote controls and sets that tune themselves automatically.

No.	SAMS	MAKE	MODEL	TYPE	YEAR
1	-	Echophone	41	table	1931
2	48	Hallicrafter	T54	table	1948
3	54	RCA	630	table	1949
4	54	RCA	8TS30	table	1949
5	55	Motorola	VT71	table	1949
6	59	Admiral	19A1	table	1949
7	62	Pilot	TV37	table	1949
8	69	Bendix	235B1	table	1949
9	71	Motorola	VT73	Portable	1949
10	73	Sentinal	400TV	Portable	1949
11	73	Sentinal	400TVM	table	1949
12	74	RCA	8T241	table	1949
13	77	Admiral	4H1419	table	1949
14	82	Airline	84GSE30	table	1950
15	83	Motorola	7VT1	table	1950
16	90	RCA (proj)	9PC41A	Floor	1950
17	336	RCA	8PT3070	Port	1956
18	339	RCA (color	21CD8777	floor	1958
19	466	Philco	UN4432	floor	1959
20	466	Philco	UN4432	table	1959
21	550	RCA (color	212G806	floor	1961
22	681	Truetone	2DC1414	floor	1964
23	732	PHilco	UN2622	port	1965

"WHY, I'M ALWAYS GLAD TO HELP OUT NEWCOMERS IN ATV — ONE OF THE BEST MAGAZINES WITH ALOT OF GREAT INFORMATION IS ..."

AMATEUR RADIO TELEVISION TODAY (Editor)

Many of the same experimentors with radio and television were "Hams" and actually carried out their hobby testing under an Amateur license. It was just a matter of time before the electronic process would advance far enough for Amateurs to build inexpensive converters, receivers and video modulated transmitters sending these TV pictures across towns and counties with eventual longer distances across states with the use of very broadbanded, high-gain, multielement beam antennas. The "first" ATV Repeater was given the go ahead by the FCC after persistent efforts of Bruce J. Brown WB4YTU and the world's first Amateur Television Repeater system "WR4AAG" was on the air! A period of threatening (so called "restructuring" by the FCC) existed in 1976 entitled RM-2507 but was repealed after an organized effort by A5 Magazine and Henry Ruh of Whitmore Lake, Michigan. The rest is modern history with state of art transistorized ATV transceivers, FM sub-carrier or on-carrier sound & video special effect ID'ers and generators. The beginning of 1982 revealed the world's first all transistorized (including the tube) color camera and combination videocassette mini-recorders within a color camera unit. ATV is a commonplace mode of operation in just about every part of the country with many repeaters, groups or clubs in active operation. It started with Marconi and Radio and who knows what television will eventuallly progress into. The important thing is to be a part of it, and you can with Amateur Television!

JERROLD

TV CHANNEL DATA

CH	FREQ. RANGE IN MHz	CARRIERS IN MHz			WAVE LENGTHS IN INCHES*		
		VIDEO	COLOR	SOUND	AIR	** JD COAX	*** JA COAX
LO-VHF	54-88	—	—	—	—	—	—
2	54-60	55.25	58.83	59.75	214	197	173
3	60-66	61.25	64.83	65.75	193	178	156
4	66-72	67.25	70.83	71.75	176	162	142
5	76-82	77.25	80.83	81.75	153	141	124
6	82-88	83.25	86.83	87.75	142	130	115
FM	88-108	—	—	—	—	—	—
HI-VHF	174-216	—	—	—	—	—	—
7	174-180	175.25	178.83	179.75	67	62	54
8	180-186	181.25	184.83	185.75	65	60	52
9	186-192	187.25	190.83	191.75	63	58	51
10	192-198	193.25	196.83	197.75	61	56	49
11	198-204	199.25	202.83	203.75	59	54	48
12	204-210	205.25	208.83	209.75	57	52	46
13	210-216	211.25	214.83	215.75	55	51	45
SUB-VHF	5.75-47.75	—	—	—	—	—	—
T-7	5.75-11.75	7	10.58	11.5	—	1551	1366
T-8	11.75-17.75	13	16.58	17.5	—	835	735
T-9	17.75-23.75	19	22.58	23.5	—	571	503
T-10	23.75-29.75	25	28.58	29.5	—	434	382
T-11	29.75-35.75	31	34.58	35.5	—	350	308
T-12	35.75-41.75	37	40.58	41.5	—	299	258
T-13	41.75-47.75	43	46.58	47.5	—	252	222

MID-BAND • HI-VHF

CH	FREQ. RANGE IN MHz	CARRIERS IN MHz			WAVE LENGTHS IN INCHES*		
		VIDEO	COLOR	SOUND	AIR	** JD COAX	*** JA COAX
MID-BAND	120-174	—	—	—	—	—	—
A	120-126	121.25	124.83	125.75	—	89	79
B	126-132	127.25	130.83	131.75	—	85	75
C	132-138	133.25	136.83	137.75	—	81	71
D	138-144	139.25	142.83	143.75	—	78	68
E	144-150	145.25	148.83	149.75	—	74	65
F	150-156	151.25	154.83	155.75	—	71	63
G	156-162	157.25	160.83	161.75	—	69	60
H	162-168	163.25	166.83	167.75	—	66	58
I	168-174	169.25	172.83	173.75	—	64	56

SUPER-BAND

CH	FREQ. RANGE IN MHz	CARRIERS IN MHz			WAVE LENGTHS IN INCHES*		
		VIDEO	COLOR	SOUND	AIR	** JD COAX	*** JA COAX
SUP-BAND	216-300	—	—	—	—	—	—
J	216-222	217.25	220.83	221.75	—	50	44
K	222-228	223.25	226.83	227.75	—	48	42
L	228-234	229.25	232.83	233.75	—	47	41
M	234-240	235.25	238.83	239.75	—	46	40
N	240-246	241.25	244.83	245.75	—	45	39
O	246-252	247.25	250.83	251.75	—	38	43
P	252-258	253.25	256.83	257.75	—	42	37
Q	258-264	259.25	262.83	263.75	—	41	36
R	264-270	265.25	268.83	269.75	—	40	35
S	270-276	271.25	274.83	275.75	—	39	34
T	276-282	277.25	280.83	281.75	—	38	33.5
U	282-288	283.25	286.83	287.75	—	38	33
V	288-294	289.25	292.83	293.75	—	37	33
W	294-300	295.25	298.83	299.75	—	36	32

UHF

CH	FREQ. RANGE IN MHz	CARRIERS IN MHz			WAVE LENGTHS IN INCHES*		
		VIDEO	COLOR	SOUND	AIR	** JD COAX	*** JA COAX
UHF	470-890	—	—	—	—	—	—
14	470-476	471.25	474.83	475.75	25	23	20.2
20	506-512	507.25	410.83	511.75	23	21	18.6
27	548-554	549.25	552.83	553.75	21.5	19.5	17.5
35	596-602	597.25	600.83	601.75	20	18.2	16.2
42	638-644	639.25	642.83	643.75	18.5	17	15
50	686-692	687.25	690.83	691.75	17	15.5	13.7
60	746-752	747.25	750.83	751.75	15.5	14	12.5
70	806-812	807.25	810.83	811.75	14.5	13	11.7

*All measurements at video carrier.
**Polystyrene, velocity of propagation .92.
***Polyethylene, velocity of propagation .81.

USEFUL FORMULAS

$$\text{Wavelength in Meters (Air)} = \frac{300}{\text{Freq. in MHz}}$$

$$\text{Wavelength in Feet (Air)} = \frac{984}{\text{Freq. in MHz}}$$

E (Volts) = I (Amps) x R (Ohms)

$$\text{Power W (Watts)} = \frac{E^2 \text{ (Volts)}}{\text{R (Ohms)}}$$

Temperature Conversion

$$F° = C° \times \frac{9}{5} + 32$$

Ef (Field Intensity in Microvolts per Meter) = 0.021 E (Field Strength Meter Reading in Microvolts Using Reference Dipole) x f (frequency in MHz)

UHF Channels 14 to 83

Frequencies 470-890 MHz

To Find Center Frequency of Any UHF Channel

C.F. = 473 + 6 (Channel Number—14)

USEFUL INFORMATION

The ratio of the difference in attenuation in coaxial cable for any two frequencies carried by the cable is approximately the square root of the ratio of the two frequencies. Example: Lo-Channel 54 MHz, Hi-Channel 216 MHz. $216 \div 54 = 4$; $\sqrt{4} = 2$ or the high channel has twice as much attenuation as the low channel.

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FCC RADIATION STANDARDS

Maximum cable-system radiation level allowed by FCC standards. Values are in dBmV, as read on a peak-reading level meter using a cut, folded-dipole antenna.

CH	LEVEL	CH	LEVEL	CH	LEVEL	CH	LEVEL
T7	−20	6	−40	8	−46	O	−51
T8	−26	A	−43	9	−46	P	−52
T9	−29	B	−43	10	−46	Q	−52
T10	−32	C	−43	11	−47	R	−52
T11	−33	D	−44	12	−47	S	−52
T12	−35	E	−44	13	−47	T	−52
T13	−36	F	−44	J	−50	U	−52
2	−36	G	−45	K	−50	V	−53
3	−37	H	−45	L	−51	W	−53
4	−38	I	−45	M	−51		
5	−39	7	−46	N	−51		

Values listed in table are to the nearest lower dB, based on formula from page 11. Cable attenuation or any other gain or loss device must be considered when measurements are made. From ch. 2 to ch. 13 and from ch. A to ch. I, measurements are made at 10 ft. All others are made at 100 ft. To permit all measurements to be made at 10 ft., subtract 20 dB from indicated reading for ch. T7 through T13 and ch. J through W.

Courtesy of:

JERROLD CATV SYSTEMS
Eastern Regional Office
200 Witmer Road
Horsham, Pennsylvania 19044

TV CHANNELS - WORLDWIDE

COURTESY OF

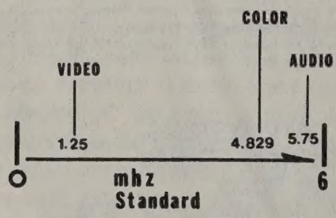
MICROWAVE FILTER COMPANY, INC. 6743 Kinne St., E. Syracuse, NY, USA 13057

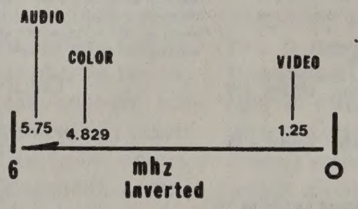
US & CANADA

CHAN	BW(MHz)	PIX	COLOR	SOUND
SUB-BAND				
T-7	5.75-11.75	7.00	10.58	11.50
T-8	11.75-17.75	13.00	16.58	17.50
T-9	17.75-23.75	19.00	22.58	23.50
T-10	23.75-29.75	25.00	28.58	29.50
T-11	29.75-35.75	31.00	34.58	35.50
T-12	35.75-41.75	37.00	40.58	41.50
T-13	41.75-47.75	43.00	46.58	47.50
VHF-LOW BAND				
TVIF	40-46	41.25	44.83	45.75
2	54-60	55.25	58.83	59.75
3	60-66	61.25	64.83	65.75
4	66-72	67.25	70.83	71.75
5	76-82	77.25	80.83	81.75
6	82-88	83.25	86.83	87.75
FM (PSEUDO)*				
FM-1	88-94	89.25	92.83	93.75
FM-2	94-100	95.25	98.83	99.75
FM-3	100-106	101.25	104.83	105.75
VHF-MID BAND				
A-2	108-114	109.25	112.83	113.75
A-1	114-120	115.25	118.83	119.75
A	120-126	121.25	124.83	125.75
B	126-132	127.25	130.83	131.75
C	132-138	133.25	136.83	137.75
D	138-144	139.25	142.83	143.75
E	144-150	145.25	148.83	149.75
F	150-156	151.25	154.83	155.75
G	156-162	157.25	160.83	161.75
H	162-168	163.25	166.83	167.75
I	168-174	169.25	172.83	173.75
VHF-HIGH BAND				
7	174-180	175.25	178.83	179.75
8	180-186	181.25	184.83	185.75
9	186-192	187.25	190.83	191.75
10	192-198	193.25	196.83	197.75
11	198-204	199.25	202.83	203.75
12	204-210	205.25	208.83	209.75
13	210-216	211.25	214.83	215.75
VHF-SUPER BAND				
J	216-222	217.25	220.83	221.75
K	222-228	223.25	226.83	227.75
L	228-234	229.25	232.83	233.75
M	234-240	235.25	238.83	239.75
N	240-246	241.25	244.83	245.75
O	246-252	247.25	250.83	251.75
P	252-258	253.25	256.83	257.75
Q	258-264	259.25	262.83	263.75
R	264-270	265.25	268.83	269.75
S	270-276	271.25	274.83	275.75
T	276-282	277.25	280.83	281.75
U	282-288	283.25	286.83	287.75
V	288-294	289.25	292.83	293.75
W	294-300	295.25	298.83	299.75

CHAN	BW(MHz)	PIX	COLOR	SOUND
UHF				
14	470-476	471.25	474.83	475.75
15	476-482	477.25	480.83	481.75
16	482-488	483.25	486.83	487.75
17	488-494	489.25	492.83	493.75
18	494-500	495.25	498.83	499.75
19	500-506	501.25	504.83	505.75
20	506-512	507.25	510.83	511.75
21	512-518	513.25	516.83	517.75
22	518-524	519.25	522.83	523.75
23	524-530	525.25	528.83	529.75
24	530-536	531.25	534.83	535.75
25	536-542	537.25	540.83	541.75
26	542-548	543.25	546.83	547.75
27	548-554	549.25	552.83	553.75
28	554-560	555.25	558.83	559.75
29	560-566	561.25	564.83	565.75
30	566-572	567.25	570.83	571.75
31	572-578	573.25	576.83	577.75
32	578-584	579.25	582.83	583.75
33	584-590	585.25	588.83	589.75
34	590-596	591.25	594.83	595.75
35	596-602	597.25	600.83	601.75
36	602-608	603.25	606.83	607.75
37	608-614	609.25	612.83	613.75
38	614-620	615.25	618.83	619.75
39	620-626	621.25	624.83	625.75
40	626-632	627.25	630.83	631.75
41	632-638	633.25	636.83	637.75
42	638-644	639.25	642.83	643.75
43	644-650	645.25	648.83	649.75
44	650-656	651.25	654.83	655.75
45	656-662	657.25	660.83	661.75
46	662-668	663.25	666.83	667.75
47	668-674	669.25	672.83	673.75
48	674-680	675.25	678.83	679.75
49	680-686	681.25	684.83	685.75
50	686-692	687.25	690.83	691.75
51	692-698	693.25	696.83	697.75
52	698-704	699.25	702.83	703.75
53	704-710	705.25	708.83	709.75
54	710-716	711.25	714.83	715.75
55	716-722	717.25	720.83	721.75
56	722-728	723.25	726.83	727.75
57	728-734	729.25	732.83	733.75
58	734-740	735.25	738.83	739.75
59	740-746	741.25	744.83	745.75
60	746-752	747.25	750.83	751.75
61	752-758	753.25	756.83	757.75
62	758-764	759.25	762.83	763.75
63	764-770	765.25	768.83	769.75
64	770-776	771.25	774.83	775.75
65	776-782	777.25	780.83	781.75
66	782-788	783.25	786.83	787.75
67	788-794	789.25	792.83	793.75
68	794-800	795.25	798.83	799.75
69	800-806	801.25	804.83	805.75
70	806-812	807.25	810.83	811.75
71	812-818	813.25	816.83	817.75
72	818-824	819.25	822.83	823.75
73	824-830	825.25	828.83	829.75
74	830-836	831.25	834.83	835.75
75	836-842	837.25	840.83	841.75
76	842-848	843.25	846.83	847.75
77	848-854	849.25	852.83	853.75
78	854-860	855.25	858.83	859.75
79	860-866	861.25	864.83	865.75
80	866-872	867.25	870.83	871.75
81	872-878	873.25	876.83	877.75
82	878-884	879.25	882.83	883.75
83	884-890	885.25	888.83	889.75

US - CANADIAN INTRA-CHANNEL CARRIER PLACEMENT





Catalog C/80
Price $1.00

CHNL.	PIX	SOUND
AUSTRALIAN		
A-0	51.75	46.25
A-1	62.75	57.25
A-2	69.75	64.25
A-3	91.75	86.25
A-4	100.75	95.25
A-5	107.75	102.25
A-5A	143.75	138.25
A-6	180.75	175.25
A-7	187.75	182.25
A-8	194.75	189.25
A-9	201.75	196.25
A-10	214.75	209.25
A-11	222.00	215.00
EASTERN EUROPEAN		
OIRT-1	49.75	56.25
OIRT-2	59.25	65.75
OIRT-3	77.25	83.75
OIRT-4	85.25	91.75
OIRT-5	93.25	99.75
OIRT-6	175.25	181.75
OIRT-7	183.25	189.75
OIRT-8	191.25	197.75
OIRT-9	199.25	205.75
OIRT-10	207.25	213.75
OIRT-11	215.25	221.75
OIRT-12	223.25	229.75
FRENCH		
F-2	52.40	41.25
F-4	65.55	54.40
F-5	164.00	175.15
F-6	173.40	162.25
F-7	177.15	188.30
F-8A	185.25	174.10
F-8	186.55	175.40
F-9	190.30	201.45
F-10	199.70	188.55
F-11	203.45	214.60
F-12	212.85	201.70
FRENCH OVERSEAS		
F-4	175.25	161.75
F-5	183.25	180.75
F-6	191.25	197.75
F-7	199.25	205.75
F-8	207.25	213.75
F-9	215.25	221.75
ITALIAN		
A	53.75	59.25
B	62.25	67.75
C	82.25	87.75
D	175.25	180.75
E	183.75	189.25
F	192.25	197.75
G	201.25	206.75
H	210.25	215.75
H-1	217.25	222.75

SOUTH AFRICAN CHANNELS

CHNL	BW(MHz)	PIX	SND
4	174-182	175.25	181.25
5	182-190	183.25	189.25
6	190-198	191.25	197.25
7	198-206	199.25	205.25
8	206-214	207.25	213.25
9	214-222	215.25	221.25
10	222-230	223.25	229.25
11	230-238	231.25	237.25
13		247.43	253.43
21	470-478	471.25	477.25
22	478-486	479.25	485.25
23	486-494	487.25	493.25
24	494-502	495.25	501.25
25	502-510	503.25	509.25
26	510-518	511.25	517.25
27	518-526	519.25	525.25
28	526-534	527.25	533.25
29	534-542	535.25	541.25
30	542-550	543.25	549.25
31	550-558	551.25	557.25
32	558-566	559.25	565.25
33	566-574	567.25	573.25
34	574-582	575.25	581.25
35	582-590	583.25	589.25
36	590-598	591.25	597.25
37	598-606	599.25	605.25
39	614-622	615.25	621.25
40	622-630	623.25	629.25
41	630-638	631.25	637.25
42	638-646	639.25	645.25
43	646-654	647.25	653.25
44	654-662	655.25	661.25
45	662-670	663.25	669.25
46	670-678	671.25	677.25
47	678-686	679.25	685.25
48	686-694	687.25	693.25
49	694-702	695.25	701.25
50	702-710	703.25	709.25
51	710-718	711.25	717.25
52	718-726	719.25	725.25
53	726-734	727.25	733.25
54	734-742	735.25	741.25
55	742-750	743.25	749.25
56	750-758	751.25	757.25
57	758-766	759.25	765.25
58	766-774	767.25	773.25
59	774-782	775.25	781.25
60	782-790	783.25	789.25
61	790-798	791.25	797.25
62	798-806	799.25	805.25
63	806-814	807.25	813.25
64	814-822	815.25	821.25
65	882-830	823.25	829.25
66	830-838	831.25	837.25
67	838-846	839.25	845.25
68	846-854	847.25	853.25

JAPANESE

CHNL	PIX	SND
J-1	91.25	95.75
J-2	97.25	101.75
J-3	103.25	107.75
J-4	171.25	175.75
J-5	177.25	181.75
J-6	183.25	187.75
J-7	189.25	193.75
J-8	193.25	197.75
J-9	199.25	203.75
J-10	205.25	209.75
J-11	211.25	215.75
J-12	217.25	221.75
J-45	663.25	667.75
J-46	669.25	673.75
J-47	675.25	679.75
J-48	681.25	685.75
J-49	687.25	691.75
J-50	693.25	697.75
J-51	699.25	703.75
J-52	705.25	709.75
J-53	711.25	715.75
J-54	717.25	721.75
J-55	723.25	727.75
J-56	729.25	733.75
J-57	735.35	739.75
J-58	741.25	745.75
J-59	747.25	751.75
J-60	753.25	757.75
J-61	759.25	763.75
J-62	765.25	769.75

BRITISH

B-1	45.00	41.50
B-2	51.75	48.25
B-3	56.75	53.25
B-4	61.75	58.25
B-5	66.75	63.25
B-6	179.75	176.25
B-7	184.75	181.25
B-8	189.75	186.25
B-9	194.75	191.25
B-10	199.75	196.25
B-11	204.75	201.25
B-12	209.75	206.25
B-13	214.75	211.25
B-14	219.75	216.25

WESTERN EUROPEAN (E) CHANNELS

CHAN	BW(MHz)	PIX	COLOR	SOUND
2	47-54	48.25	52.68	53.75
3	54-61	55.25	59.68	60.75
4	61-68	62.25	66.68	67.75
S-3	118-125	119.25	123.68	124.75
S-4	125.132	126.25	130.68	131.75
S-5	132-139	133.25	137.68	138.75
S-6	139-146	140.25	144.68	145.75
S-7	146-153	147.25	151.68	152.75
S-8	153-160	154.25	158.68	159.75
S-9	160-167	161.25	165.68	166.75
S-10	167-174	168.25	172.68	173.75
5	174-181	175.25	179.68	180.75
6	181-188	182.25	186.68	187.75
7	188-195	189.25	193.68	194.75
8	195-202	196.25	200.68	201.75
9	202-209	203.25	207.68	208.75
10	209-216	210.25	214.68	215.75
11	216-223	217.25	221.68	222.75
12	223-230	224.25	228.68	229.75
S-11	230-237	231.25	235.68	236.75
S-12	237-244	238.25	242.68	243.75
S-13	244-251	245.25	249.68	250.75
S-14	251-258	252.25	256.68	257.75
S-15	258-265	259.25	263.68	264.75
S-16	265-272	266.25	270.68	271,75
S-17	272-279	273.25	277.68	278.75
21	470-478	471.25	475.68	476.75
22	478-486	479.25	483.68	484.75
23	486-494	487.25	491.68	492.75
24	494-502	495.25	499.68	500.75
25	502-510	503.25	507.68	508.75
26	510-518	511.25	515.68	516.75
27	518-526	519.25	523.68	524.75
28	526-534	527.25	531.68	532.75
29	534-542	535.25	539.68	540.75
30	542-550	543.25	547.68	548.75
31	550-558	551.25	555.68	556.75
32	558-566	559.25	563.68	564.75
33	566-574	567.25	571.68	572.75
34	574-582	575.25	579.68	580.75
35	582-590	583.25	587.68	588.75
36	590-598	591.25	595.68	596.75
37	598-606	599.25	603.68	604.75
38	606-614	607.25	611.68	612.75
39	614-622	615.25	619.68	620.75
40	622-630	623.25	627.68	628.75
41	630-638	631.25	635.68	636.75
42	638-646	639.25	643.68	644.75
43	646-654	647.25	651.68	652.75
44	654-662	655.25	659.68	660.75
45	662-670	663.25	667.68	668.75
46	670-678	671.25	675.68	676.75
47	678-686	679.25	683.68	684.75
48	686-694	687.25	691.68	692.75
49	694-702	695.25	699.68	700.75
50	702-710	703.25	707.68	708.75
51	710-718	711.25	715.68	716.75
52	718-726	719.25	723.68	724.75
53	726-734	727.25	731.68	732.75
54	734-742	735.25	739.68	740.75
55	742-750	743.25	747.68	748.75
56	750-758	751.25	755.68	756.75
57	758-766	759.25	763.68	764.75
58	766-774	767.25	771.68	772.75
59	774-782	775.25	779.68	780.75
60	782-790	783.25	787.68	788.75
61	790-798	791.25	795.68	796.75
62	798-806	799.25	803.68	804.75
63	806-814	807.25	811.68	812.75
64	814-822	815.25	819.68	820.75
65	822-830	823.25	827.68	828.75
66	830-838	831.25	835.68	836.75
67	838-846	839.25	843.68	844.75
68	846-854	847.25	851.68	852.75
69	854-862	855.25	859.68	860.75

FM CHANNEL FREQUENCIES

Channel-MHz	Channel-MHz	Channel-MHz	Channel-MHz	Channel-MHz	Channel-MHz
201.....88.1	218.....91.5	235.....94.9	252.....98.3	269....101.7	286....105.1
202.....88.3	219.....91.7	236.....95.1	253.....98.5	270....101.9	287....105.3
203.....88.5	220.....91.9	237.....95.3	254.....98.7	271....102.1	288....105.5
204.....88.7	221.....92.1	238.....95.5	255.....98.9	272....102.3	289....105.7
205.....88.9	222.....92.3	239.....95.7	256.....99.1	273....102.5	290....105.9
206.....89.1	223.....92.5	240.....95.9	257.....99.3	274....102.7	291....106.1
207.....89.3	224.....92.7	241.....96.1	258.....99.5	275....102.9	292....106.3
208.....89.5	225.....92.9	242.....96.3	259.....99.7	276....103.1	293....106.5
209.....89.7	226.....93.1	243.....96.5	260.....99.9	277....103.3	294....106.7
210.....89.9	227.....93.3	244.....96.7	261....100.1	278....103.5	295....106.9
211.....90.1	228.....93.5	245.....96.9	262....100.3	279....103.7	296....107.1
212.....90.3	229.....93.7	246.....97.1	263....100.5	280....103.9	297....107.3
213.....90.5	230.....93.9	247.....97.3	264....100.7	281....104.1	298....107.5
214.....90.7	231.....94.1	248.....97.5	265....100.9	282....104.3	299....107.7
215.....90.9	232.....94.3	249.....97.7	266....101.1	283....104.5	300....107.9
216.....91.1	233.....94.5	250.....97.9	267....101.3	284....104.7	
217.....91.3	234.....94.7	251.....98.1	268....101.5	285....104.9	

NOTES:

(1) 88-108MHz reserved for FM broadcast service in Canada and U.S.

(2) 88-92MHz reserved for non-commerical educational broadcasting.

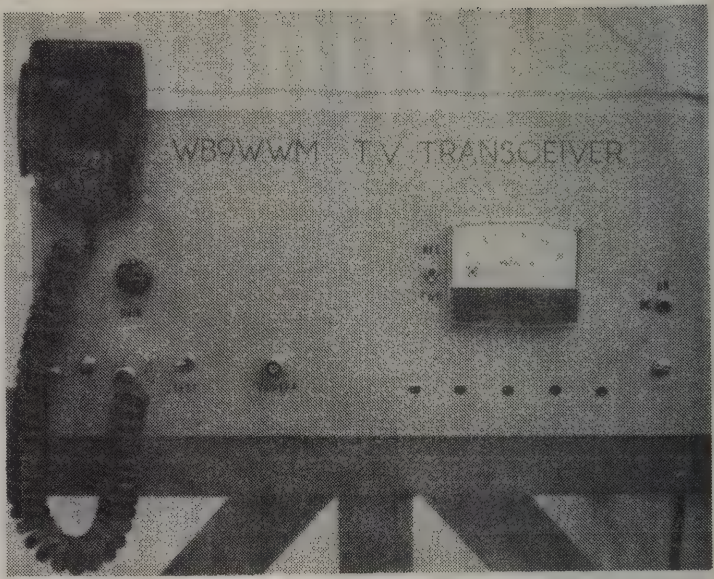
CHAPTER 2
WHAT YOU NEED
by Henry B. Ruh

TV is not a mystical venture although many are frightened by the mere mention of the word. TV is simple amplitude modulation. True, the video frequencies are higher than good old voice, but if you can build a 40 meter rig, you have already delt with frequencies higher than you will ever see in your home video system.

To receive and transmit TV pictures, you need the normal elementary items: transmitter, receiver, camera, antenna. A few of these items you may already have, such as a TV set. Any ordinary TV set. Preferably, stress that as meaning needed, one which has a transformer power supply, no hot chassis please! You need a converter, to hetrodyne the incomming UHF TV signal to a frequency your set can receive. (ATV is on 420-450 and 1215-1300 Mhz) This can be an expensive commercial ATV converter, a converted UHF TV tuner, a $10 surplus varactor TV tuner such as those offered by Science Workshop or some homebrew who knows what device designed by you or someone else. This is all you need to receive, so the cost can be as low as $10 or less. If you opt for a good preamp, needed for real DX for those who live 200 miles from somewhere, then plan on another 30-50 bucks. To transmit, you need a TV camera. Any camera will do. It can be a closed circuit throw-away, a build-it-yourself, a kit built (ATV Research makes a dandy TV camera kit, which will also teach you about video and cameras) or you can buy any new camera which catches your eye. The only requirement is that the camera provide a composit video signal; one which has both video and sync. Since few cameras you will ever come across provide noncomposit signals, this is your least important problem. You can save a lot by checking hamfests and used video equipment dealers.

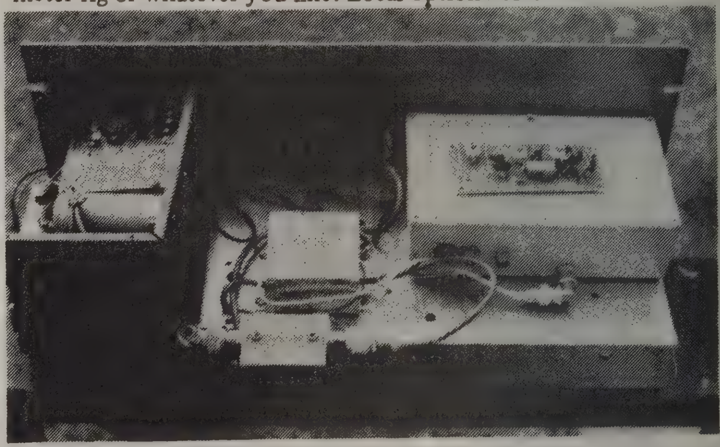
Henry Ruh works on some camera equipment at home in Indiana

You need a transmitter. (seems obvious I know) This could be a VHF Engineering TX432, or a two meter transmitter with a varactor tripler, or any other 450 MHz transmitter. Most of us started with RCA CMU-15 and Motorola T-44 transmitters, which, while on the wane, are still used, but getting scarce. I do not recommend buying a tube transmitter since they are more difficult to video modulate than the solid state rigs, use more power than they put out (by 4X) and good solid state rigs are cheap enough anyway. There are a number of commercial TV transmitters available if you do not want to build or convert any of the other rigs I mention later. There is a manufacturers index later in this book, and some of the good folks in ATV have helped sponser the production of this book.



Typical homebrew ATV transceiver. Unit pictured was described in detail in April 1978 issue of QST. Fig 2

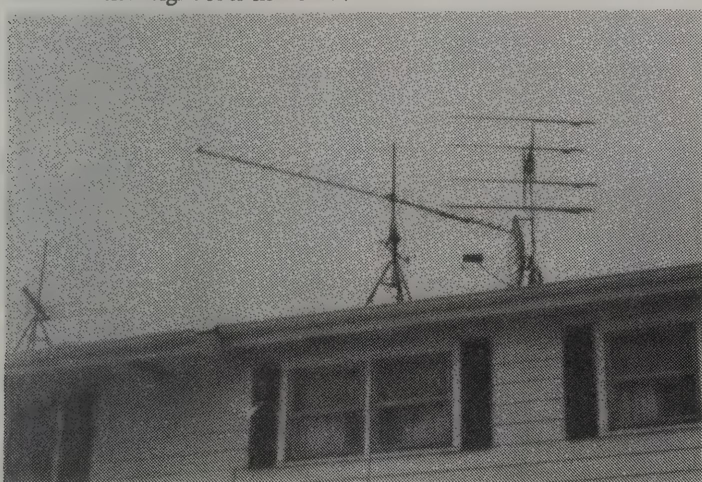
The way you get your video on the air is simple. First, after choosing what transmitter you will use, you build or buy the corresponding video modulator suggested. The video modulator is nothing but a low impedance output high power video amplifier, which is to say, simply a low frequency power amplifier. These are simple to knock together in an hour or less, are not critical, can be breadboarded, perf board, built on terminal strips or hung together in thin air by the component leads. The rumors you heard about video being tough is a lot of bull feathers. Your camera puts out a signal which is usually about 1 volt p-p, and the video modulator pumps this up to what ever voltage your rig requires to amplitude modulate the beast to 80-90%. If your rig is a regular FM UHF rig, you have built in audio transmitter as well. If not, then you might want an FM sub carrier generator (another small simple unit to generate a 4.5 MHz signal) or a second small TX for sound or use your two meter rig or whatever you like. Local option here.



Receive side of unit in picture 2. Small PC board is PC Electronics ATV tunable converter and RF amp. Box under it is Janel Deluxe ATV converter in RF tight box. Central unit is TX relay, Bird RF sensor. To left, power supply. Fig 3

The antenna should be a work of art. Almost nothing is more important than the antenna for UHF and ATV work. The bigger the better. (A receive preamp is super No. 2 on the important list, along with good coax). Power is not needed at UHF except for an all out DX chasing attempt, which usually requires 100 watts or more output.

The antenna should be on the highest point of your tower. 70 feet is a good working height. Trees and other biodegradable items suck up RF like a Bounty paper towel sucks up water. The best antennas used are the Rhomboid, typicallly 26 DB gain (contact W8DMR for this one), the Colinear (described later or the Cush Craft DX-420), the Quagi or Yagi, in fours, such as the J-Beam 48MBM Multi-beam, or the KLM 27 element Yagi. Quad stacked boys. You can do with less, but the name of the game is antenna gain, and 20 DB of antenna gain means 20 DB of receive gain AND 20 DB of transmit gain, makes your 10 watts TX output equal to a kilowatt. Good coax is also a must. No RG-58 no CB shop RG-8 fish net shielded loss leader. Its corregated or aluminum jacketed hard line except for the tail to the antenna above the rotor. Its type N or BNC connectors. Cost is higher, but for UHF and ATV it is necessary. If by some freak of nature you manage to live at the top of a tall building and have a cable run of 20 feet, or a tower mounted receiver/transmitter, then the commercial grade of RG-8 can be used. Coax loss works on both transmit and receive, so a loss of 3 DB in the coax is 3 DB on receive and transmit, meaning a system loss of 6 DB. The little DB's are important and they add up fast. The coax can be gotten fairly cheaply. Cable TV alumiline, often foundat hamtests can be used, 75 or 50 ohm, matters not which. Your receiver and transmitter will work with both. There is some marginal difference for you purists, but for most folks, the savings over buying new goodies well compensates for the slight loss involved.



4 KLM 27 element YAGI's for ATV and an 11 element 2 meter antenna adorn roof of ATV DX'er Ron K9Z1H

About now you may be wondering how far you can QSO. Most folks have no problem reaching 10-20 miles with low power. If you have 10-25 watts, a hot preamp and a decent antenna, 20-60 miles is normal depending on terrain more than anything else. High power, 60 or more miles any time. The US ATV DX record presently belongs to W3POS in Erie, PA and W9ZIH in Hickory Hills, IL, about 440 miles. Many 200+ mile QSO's have been documented, many are common place. DX on UHF is a real thrill. You need to be there when the band opens to appreciate looking at Toledo from Chicago with 100 watts of TX power! The DX madness demands watching for openings on the low channel UHF TV frequencies, channels 14-25, and then beaming a CQ in that direction. It's done all the time.

Normally, your range will be limited to about 40-60 miles. You might live in an area which is blessed with an ATV repeater. This allows mediocre equipment to work all over the place, and allows group QSO's and many other items. There is an ATV repeater directly later also.

ATV EQUIPMENT AND INFORMATION DIRECTORY

A5 ATV Magazine P.O. Box H Lowden, IA 52255	13
Advanced Receiver Research P.O. Box 1242 Burlington, CT 06013	2, 4
Aptron Labs 3625 Grandview Bloomington, IN 47401	1, 2, 3, 9, 13
CQ-TV Magazine (BATC) 47 Crick Road Hillmorton, Rugby, England CV21 4DU	7, 13
ATV Research (Image 21) 1303 Broadway Dakota City, NE 68731	7, 8, 9, 10
Communication Concepts 2648 North Arabon Ave. Dayton, OH 45420	
Camera Corner 3522 Eastern Avenue Davenport, Iowa 52807	9
Hamtronics, Inc. 65-R Moul Road Hilton, NY 14468	1, 2, 3, 4, 6
Janel Labs 3312 SE Van Buren Blvd Corvallis, OR 97330	3, 4, 10
Mirage Comm. Equipment PO Box 1393 Gilroy, CA 95020	11
P.C. Electronics 2522 Paxson Arcadia, CA 91006	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Science Workshop Box 393 Bethpage, NY 11714	1, 2, 3, 4, 5, 7, 8, 10
Silvernail Electronics 14061-111 Terrace North Largo, FL 33540	1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 12
Systems Electronics P.O. Box 241 Glen Ellen, CA 95442	1, 2, 3, 4, 5, 7, 8, 9, 10
Spectronics 1009 Garfiled Oak Park, IL 60304	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Spectrum International PO Box 1084W Concord, MA 01742	1, 2, 3, 4, 5, 6, 7, 8, 10, 11
Webster Associates 115 Bellarmine Rochester, MI 48063	12

Product code:
1 Transmitters
2 Receivers
3 Converters
4 Preamps
5 Video modulators
6 Antennas
7 Kits
8 Special ATV parts
9 Cameras, Lenses
10 Accessories
11 ATV Linears
12 Measuring Equipment
13 Publications

Many suppliers have related items such as video monitors (TV sets which do not have an IF or tuner) test patterns, oscilloscopes, switchers, etc.

If these folks can't help you, (and they should be able to) you can check out the Yellow Pages for closed circuit TV equipment suppliers.

Build or buy

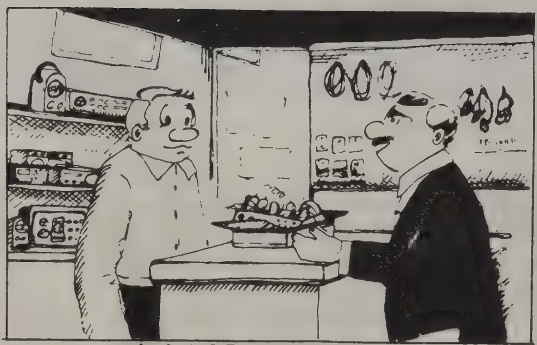
The choice to build or buy will depend on your level of interest and the condition of your wallet. While you may buy everything you need, you will learn a lot, and get a lot more enjoyment out of ATV if you build at least part of your station. The items offered by such folks as PC electronics and others have been well de-bugged and success is assured. Most of the build-it projects later in this book are based upon available kits.

There is also the certain pride in being able to pan the camera around the TV shack and point out items you have built or modified to your audience. It is also a great source of conversations and QSO's unlimited as you describe your prized pre-amp, RF amplifier and the like.

If you are not experienced in UHF work, then you may wish to buy a commercial pre-amp or converter. The transmitters are duck soup to modify (if you use any of the commercial UHF FM transmitters) and you can home brew one with a little care without much trouble.

Neat all homebrew ATV "shack" of Joe, WB2AQM.

HELP



AND I WANT IT FIXED BY TONIGHT.

All beginning ATV'ers need help. There are a few ATV clubs around in the major metro areas, but most of you reading this will probably not be living anywhere near them. Baltimore sports the BRATS home office, Box 5915, Balitmore, MD 21208. Washington, DC, Metrovision, Box 408, Falls Church, VA 22046. New York, LIMARC, 80 Birchwood, Syossett, LI, NY 11791. Nighthawk, PO Box 775, Groton, CT 06340. MIT Radio Club, Box 221, Malden, MA 02148. Southern California ATV Club, 2226 Callahan Aven. Simi Valley, California 93065. Indianapolis ATV Club, Box 95, Waldron, IN 46182.

Canadians, have some regular help thanks to a monthly column in The Ontario Amateur by George Davis VE3BBW.

Since most folks need help close at hand, there is an ATV operator directory later which should allow you to find someone close at hand. Not all of the listings are fast scan operators, some are slow scan, but video is video.

There is a regular ATV net on 40 meters. 7290 11 AM CDT or CST. Since many slow scanners also have fast scan equipment, checkout the slow scan net on 20, 14230 SAT AM. There are also a number of local and regional nets on 50.15, 145.25.

GETTING STARTED

Generating Local Activity

Hamfests, local demos and a lot of on-the-air activity is what builds activity. Talk up your ATV interest on the local FM nets and repeaters. Give a demo at the local club meeting, or start your own ATV club. Interest is contagious. Others will follow your lead if you pull them along a little. The hamfests which seem to abound in ATV goodies and folks are: Dayton (everything abounds there if you can stand the crush of humanity). Indianapolis, Cincinnati, Gaithersburg, MD, Willow Grove, VHF Pack Rats Ham-o-rama (Philly), Plymouth, IN, Bedford, IN, Toronto RSO. There are others, but these are the ones to go to if you are serious. Indy also sports one of the three best ATV clubs, drawing from five states for their three times yearly meetings.

Charles R. Hilliker
Phoenix, Arizona

Things to do on ATV

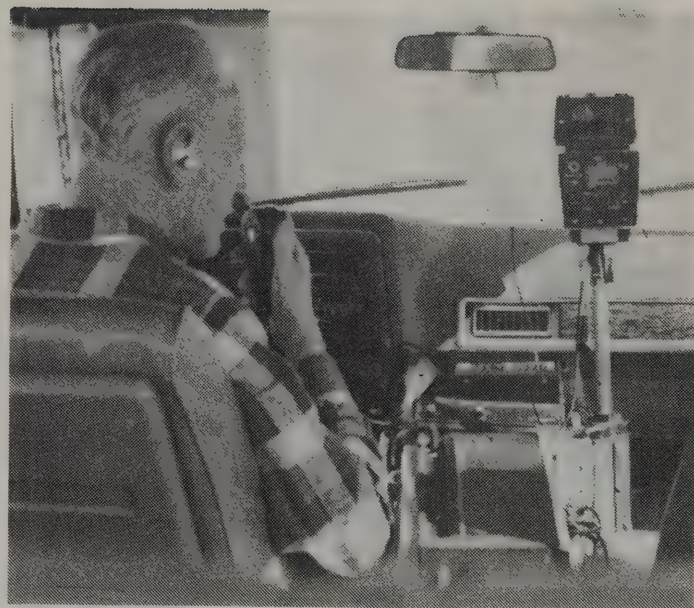
Your imagination is your best guide. While the FCC would frown on producing entertainment programs ala "Charlie's Angels", you can do most anything else. Recent activities include over-the-air Pong, using two meters to control the paddles, weather watçhing perfected by Warren Weldon W5DFU, technical nets, DX, experimenting with varied scan systems, color systems other than our regular NTSC. Low noise or novel modulation schemes, bandwidth compression and conservation techniques. Santa can visit hospitalized kids at Christmas time via ham TV, parade coverage for shut-ins, any of

a number of items. Most of the time, you will be sending pics of yourself, equipment, QSL's, shack visitors and the like to the other operators. Act natural. You don't have to stare at the camera as though you were the 6 o'clock news anchor man. Move the camera around, show folks the mess that really exists on the workbench. You can send SSTV, RTTY or whatever on the aural signal while you send the pix of your project on the fast scan modulator. You can have full duplex multiple cameras, special effects, run films, slides, video tapes, play chess, anything you like. Or, just sit there and converse, with the added enjoyment of seeing as well as hearing.

Time to start

The remainder of the book has a lot of technical material. Don't let this scare you away from ATV. The next three chapters explain what video is all about and a few basics about the equipment you will be using. The projects selected are ones which will be of direct benefit to you if you want to build your own equipment. The projects have been selected from past issues of A5, meeting handouts and other contributions.

Meanwhile, welcome to the wide open world of TV.



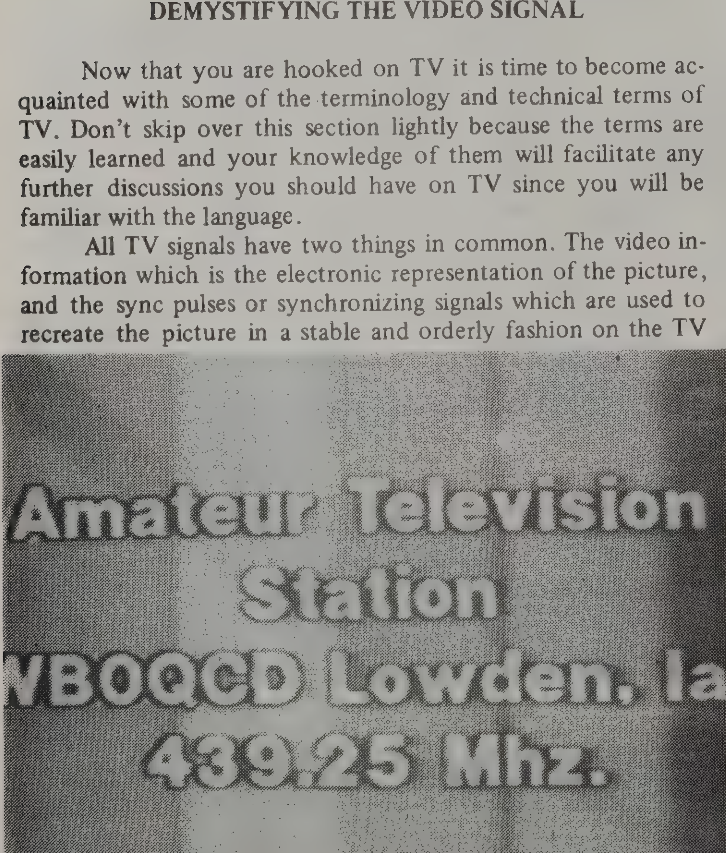
Typical mobile ATV operation, WB9WWM

Ed Piller W2KPQ checks out NYC ATV RPT.
Photo by LIMARC

CHAPTER 3
DEMYSTIFYING THE VIDEO SIGNAL

Now that you are hooked on TV it is time to become acquainted with some of the terminology and technical terms of TV. Don't skip over this section lightly because the terms are easily learned and your knowledge of them will facilitate any further discussions you should have on TV since you will be familiar with the language.

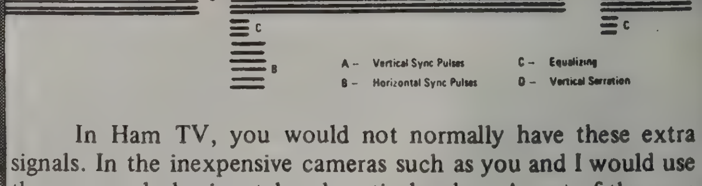
All TV signals have two things in common. The video information which is the electronic representation of the picture, and the sync pulses or synchronizing signals which are used to recreate the picture in a stable and orderly fashion on the TV screen. It is the sync pulses which control the SWEEP circuits in the TV receiver so that all the picture elements are displayed in the correct order and in the correct position on the screen.



In the camera and in the TV receiver there are two directions in which the electron beam must be moved and controlled. The one direction is from side-to-side and is called HORIZONTAL. The other direction is from top to bottom, that is called VERTICAL. Now that shouldn't be hard to remember. The vertical and horizontal SWEEP circuits are controlled by the sync pulses of the signal being received. The pulses are carefully timed so that each line of each picture starts at exactly the right time.

Because you need to be able to know when to start the two separate sweep circuits which operate at different speeds, there are two basic sizes of sync pulses. The horizontal pulses are at the beginning of each line or horizontal sweep of the electron beam. In the U.S. system (also used in Japan, Canada and other countries) the picture contains 525 lines which are sent 30 times per second. This makes the length of each line 63.5 microseconds long. The frequency is 15,734 Hz. Since we would like to send a picture, we devote most of the time of each line to the picture information and only a little amount of time to the sync pulse. In practice, about 5/6ths of the line is video and 1/6 is sync or timing information. The pulse is actually 4.5 microseconds long, with a little time left over on each side to give the scanning system time to reach the proper side of the screen.

After we have sent the picture, we need to trigger the vertical sweep circuit to return the scan to the top of the screen so we can send the next scene. Since it took much longer to scan all the horizontal lines than it did to scan just one, the vertical sweep frequency is much lower than the horizontal. The vertical sweep frequency is 59.94 Hz. Once again, we use most of the time to trace out the picture, and only a small portion of the time to send the vertical sweep pulses. There are a number of vertical pulses to each vertical sweep. In actual use it takes 21 horizontal lines to send all the vertical information. This is called the vertical interval. It is the time from the end of the first picture to the start of the next picture. The actual time is about 1100 microseconds. In broadcasting, that time is used to send more than just the vertical sync pulses. Special signals called VITS and VIR are inserted on some lines. These are Vertical Interval Test Signals and Vertical Interval Reference signals. They are used by the network and station engineers to monitor the signal levels and distortions. The VIR signal can also be used to automatically correct the signal distortions and provide a better picture.

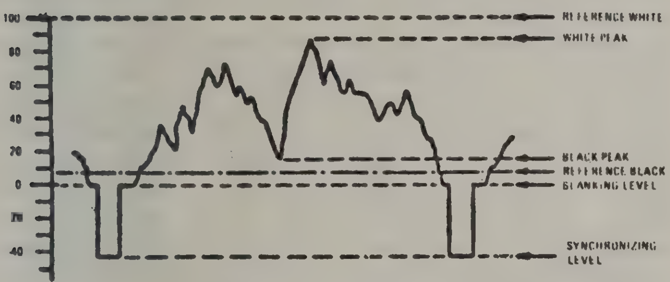


If you delay the picture on your TV by ½ line and ½ field, you will see the vertical interval pulses as shown in this "pulse" cross diagram.

In Ham TV, you would not normally have these extra signals. In the inexpensive cameras such as you and I would use there are only horizontal and vertical pulses. A part of the sync system which is not a pulse is a signal called blanking. Since we do not want to see the lines made from the beam when it is not making a picture, we want to erase or blank out the electron beam in the camera and in our receiver. This happens every time the beam ends one line and returns to start the next line. It also occurs during the time it takes to get the beam from the bottom of the picture to the top again. This is called the RETRACE

time. The time just ahead and after the sync pulses is part of the BLANKING PERIOD, the time the beam is turned off.

The video portion of the TV signal starts at the image tube. In our cameras this is generally a tube called a VIDICON. Other cameras use different tubes called Image Orthicons, Plumbicons*, saticons but the basic principles are the same. The face of the tube has a special material which is sensitive to light. Light striking the face changes the conductivity of the material in that area. As the beam crosses the face of the tube it is caused to change in strength by the photosensitive surface of the tube. This is amplitude modulation. The signalwhich starts at this point is now a graphic representation of the light level on the face of the tube along the line traced by the beam. The signal is connected to the external amplifier circuits through the TARGET ring at the front of the tube. One scan produces one line of video. The signal is then amplified to provide a level of about .7 volts.



Typical 1 Line of Video

*Registered trade mark of North American Phillips Co.

Now while your eye is sensitive to an extremely large range of light levels, from high noon under the blazing sun to the dark of night, the tube in your camera is not so tolerant. The typical vidicon tube can only reproduce a range of black to white with a ratio of 20:1. (The ratio is in foot candles) Your eye can tolerate a range of 100:1 in a normal outdoor scene, and an overall range of 10,000:1. The total range is reduced to more manageable levels by the IRIS in your eye and in the camera.

In a TV camera, the brightest object cannot have more than 20 times the amount of light as the darkest object. If its brighter, the tube cannot see that it is any brighter, and the brighter objects are all the same shade of white. Likewise, the objects darker than the camera's darkest visable object will not be seen as being any darker and will be the same shade of black. This range is called TV white and TV black. You can vary what your camera sees as TV black and TV white with the iris of the lens. The iris adjusts the amount of light which can strike the face of the tube, just as the iris in your eye limits the amount of light that enters your eye to strike the retina. On a very bright day you may wear sunglasses, likewise your camera may need a filter for operation in bright light. The vidicon tube is not as sensitive as your eye is to low light levels. The TV camera is much like a person with night blindness. Even with an excellent lens with an F stop of .95, the camera cannot see what your eye can see at night. Special tubes called image intensifiers were developed to see in the dark, but they cannot be operated in daylight.

A regular vidicon as you are likely to have in your camera needs about 50 foot candles of light to produce a good picture. If it has more light, it can produce a better picture. That's why TV studios use a lot of large lights. If you do not have enough light, the beam in the camera is reduced so it does not erase the dark images. This does cause a problem though, since the beam may be too weak to fully discharge the bright areas. This causes an after image called lag. In a properly adjusted camera, the beam is just strong enough to completely discharge the target each time it scans. This erases the image so that as soon as the beam moves from any spot, a new image can be made by the light of the image made by the lens on the face of the tube.

The image of the object which is formed by the lens on the photosensitive surface of the tube is scanned by the electron beam. The photosensitive material has the property of changing the light into a corresponding electrical charge. Each point of the image on the target is represented by a corresponding electrical charge. As the beam is moved over the surface of the target, it discharges the charge which causes the beam to be modulated in strength the result being an electronic graphic representation of the image. The beam is moved by an electromagnetic yoke, much like the yoke on your receiver's picture tube. The voltages are less because the distances and the angle of deflection overwhich the beam must be controlled is much smaller. The yoke is wound on a form which fits snugly around the glass tube. The signal present at the target connection or target ring, is amplified to a useful level by an ordinary series of transistor, tube or integrated circuits.

To understand the rhyme and reason for the sync pulses, you need to know the physical aspects of the television system. If you look closely at your TV set, you will notice that the picture is made up of many thin lines running from left to right like words on a page. Your picture tube has a chemical coating of phosphorus on the inside which emits light when an electron beam strikes it. The length of time that the screen emits the light after the beam has been turned off is called PERSISTANCE. To avoid an overlap of images as objects move across the screen the persistance must be fairly short. If the tube were to have a persistance which is considerably longer than the amount of time needed to reproduce a new picture, the pictures would overlap and the rate of motion would be restricted. If the persistance were too short, the top of the image would be fading away as the bottom of the picture was being scanned, causing a severe flicker. If you have watched a slow scan monitor which uses a very long persistance tube, you have seen how the image is bright for several lines after the beam has passed, but quickly fades out to a much dimmer picture or after image. You've seen this on your own TV set as well. When you turn off the TV in a darkened room, you will notice that the screen will continue to glow for a short while. This is from the persistance of the phosphor coating.

If you were to double the scanning rate to produce a new picture in half the time, you would reduce the flicker rate. The first TV systems for broadcasting used the available power line to time the vertical rate which was 50 or 60 Hz depending on what country you're in. To provide a signal which would fit within the desired bandwidth, it was desired to have about 525 lines per picture. To accomplish this, the information had to be rearranged to fit the bandwidth. A system called INTERLACE scanning was developed which would produce a complete picture each 1/30 second with 525 lines. What is done is to first scan all the odd numbered lines, 262.5 of them, then start over again and scan all the even numbered lines, the other 262.5. This keeps the vertical scanning rate at 60 Hz (59.94 for color) to keep the flicker to a minimum, while still reproducing a picture with 525 vertical elements (lines). Since our eyes have a persistance also, we are fooled by the system and we do not readily see the flicker. Motion resolution is preserved since the picture

is updated every 1/60 of a second. In actual use, some of the lines are not used for the picture portion of the signal, but convey the vertical sync and some test and reference signals. As a result, only about 500 lines are used for the picture. To review, each picture is produced at a rate of 30 frames per second, and each frame has two fields called odd and even, so there are 60 fields per second. Not all countries have 60 Hz power. So when their TV systems were devised, they used 50 Hz, and thus have 50 fields and 25 frames per second. Since the persistance of the tube is the same, they were able to increase the number of lines per frame from 525 to 625 and have a slightly better vertical resolution. There are other systems in use with as many as 819 lines, and some closed circuit systems operate with up to 2000 lines per frame for very fine resolution pictures.

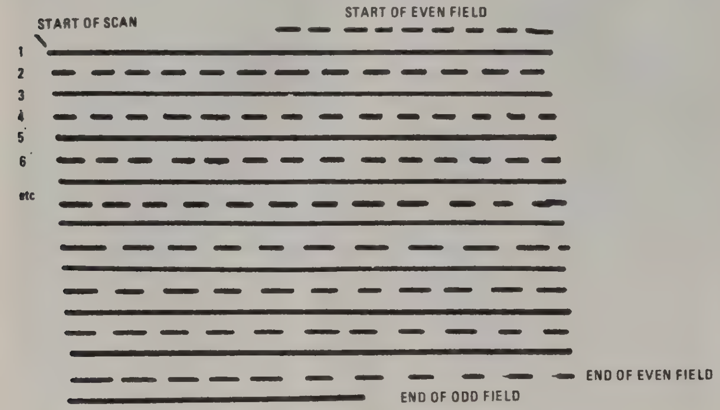
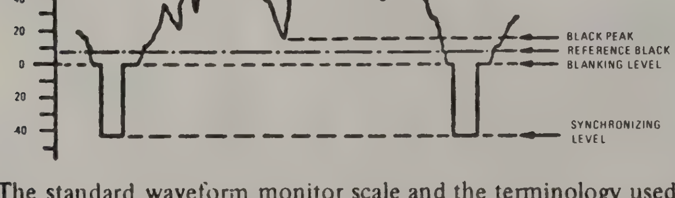


Diagram of Interlace Scanning
(2:1) Solid lines represent odd field
Dashed lines represent even field

VIDEO TERMINOLOGY

To aid the further discussion of the video signal, it is necessary to define the terms used to express the various portions of the signal. In television it is frequently necessary to refer by name to specific portions of the composit television signal. Therefore, to avoid confusion or ambiguity, a standard terminology has been adopted to identify all significant portions of the composit waveform. The six important amplitude levels of the television signal are illustrated in the figure on the following page. This is the picture signal (Fig. 2-12) for one horizontal line together with two sets of associated horizontal synchronizing and blanking pulses. The terms designated in this illustration are defined as follows:

1. REFERENCE WHITE LEVEL. The level at the point of observation corresponding to the specified maximum excursion of the picture in the white direction.
2. WHITE PEAK. The maximum excursion of the picture signal in the white direction at the time of observation.



The standard waveform monitor scale and the terminology used for measuring and identifying, respectively, the various portions of a composite picture signal.

3. BLACK PEAK. The maximum excursion of the picture signal in the black direction at the time of observation.
4. REFERENCE BLACK LEVEL. The level at the point of observation corresponding to the specified maximum excursion of the picture signal in the black direction.
5. BLANKING LEVEL. The level of the signal during the blanking interval. It coincides with the level of the base of the synchronizing pulse.
6. SYNCHRONIZING LEVEL. The level of the peaks of the synchronizing signal pulses.

1. REFERENCE WHITE. The reference white level represents the maximum permissible signal amplitude in the white direction. Normally this corresponds to that signal amplitude which insures full use of the associated facilities without overloading, cross talk, or other limiting factor becoming objectionably large. In almost every television program there is something that is white. Generally the white peaks corresponding to the white objects are adjusted until they correspond to the reference white level.

2. WHITE PEAK. At any given instant, the maximum picture signal in the white direction will have some specific amplitude. This may or may not correspond to reference white, depending upon a number of factors. These include whether or not there is truly a white object in the particular scene televised at the moment and whether the gain of the video channel is adjusted as to bring such white peaks as do exist to the reference white level. In any event, the maximum signal amplitude in the white direction that exists at the moment of observation is known as the white peak level.

3. BLACK PEAK. The blackest object in a television scene at any given moment produces a signal in the black direction whose amplitude is referred to as a black peak. The magnitude of the black peak at the instant of observation may or may not coincide with the reference black depending in factors similar to those just mentioned for the white peak signal. The darkest object in a particular scene may be gray rather than black in which case the black peak should not correspond to reference black. Again, the maximum signal excursion in the black direction that exists at the moment of measurement is made is called the black peak level.

4. REFERENCE BLACK. A signal level known as reference black is usually established, below which for several reasons, it is undesirable for black peaks to extend. Under normal conditions the black peaks corresponding to a truly black object are adjusted to come just to the reference level. Any signal peaks that extend to lower levels may be subject to compression or clipping depending on the subsequent processing of the signal by the remaining portions of the television system concerned. The reference black level is usually slightly removed from the blanking level in order to provide a margin of safety between

blanking and picture signal corresponding to the most black object in the scene.

5. BLANKING LEVEL. For television signal level measurements, it is standard practice to take the blanking level as the reference point from which all other signal amplitudes are measured. In other words it is the base line from which the five signal levels defined previously and being described here, are measured. The blanking level devides the picture waveform into two main areas, one for the video portion of the signal, the other area for the synchronizing or sync pulses.

6. SYNCHRONIZING LEVEL. The amplitude of the sync signal is determined by using the blanking level as the base. The maximum excursion of the sync pulses is known as the synchronizing or sync level.

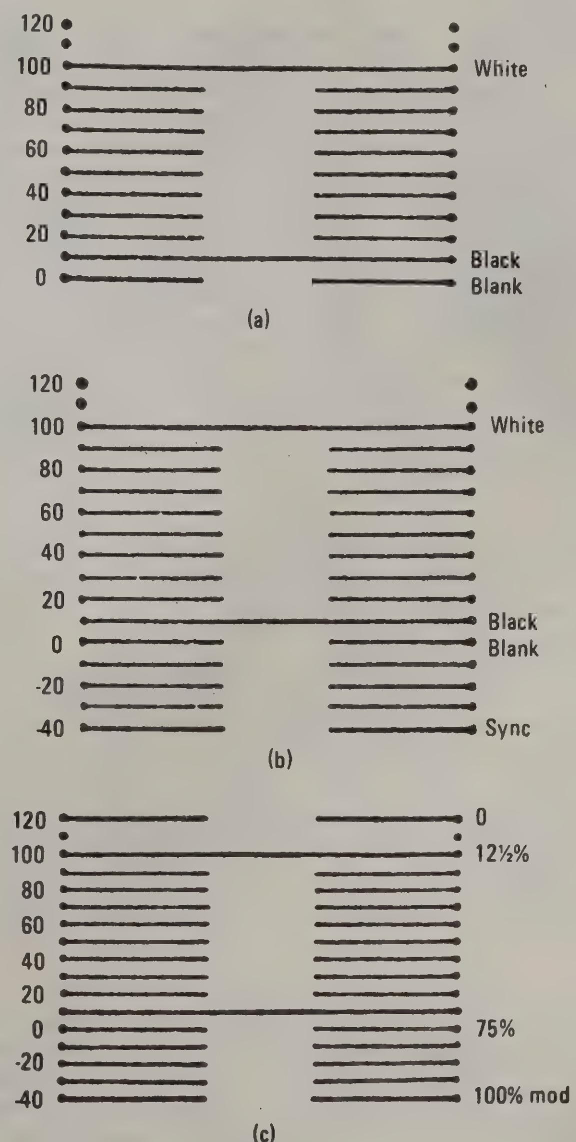
TV WAVEFORM

The oscilloscope used to observe the TV signal is called a WAVEFORM monitor. It graphically displays the video signal at two basic rates, line and field. The line rate is most known to non-TV technicians, and an example of it was used to show the various parts of the signal on the previous page. It is called line rate because the display is of the signal one line at a time. Because of the PERSISTANCE of the oscilloscope tube, you see many of the lines at a time, each superimposed on the other. Where the lines are the same amplitude at a recurring time interval, such as the sync pulses, a bright line is seen and it seems to trace out the same pattern each time. The sweep is at 15,750Hz, so you cannot see each line being traced out on the face of the tube, but you see a number of lines and can get an accurate indication of what the picture and sync information is for the scene being televised. By expanding the trace on the scope, actual pulse time measurements can be made with ease. In the field or vertical rate, the individual lines are "compressed" so an entire field can be displayed sequentially at one time. The sweep rate is 30Hz, and with a good eye, you can actually watch the sweep trace out the information. You should notice a strong flicker in the field rate, since the information is being updated at a slow rate and the tube persistance is not quite long enough to provide a picture of equal brightness between sweeps. The field rate is used to observe the entire picture to see if the black and white areas from top to bottom are uniform, or if there are abnormal shading problems, or individual lines near the top or bottom which are of an unusually high or low level.

This is a standard waveform monitor scale and together with a signal illustrating the relationship between the oscilloscope display and the scale. The position of the signal waveform is adjusted in a vertical direction with the vertical position control of the oscilloscope until the blanking level corresponds to the ZERO on the scale. The upper portion of the scale is graduated in a uniform manner from 0 to 100 and is used to read the value of black and white peaks. The graduations are called IRE or IEEE divisions.

Below the zero mark, the scale extends to 50 in linear steps and is intended for the measurement of the sync pulses. Thus these levels are expressed relative to the difference between the reference white and blanking levels rather than a percentage of the peak-to-peak signal amplitude. By choosing the blanking level as the reference point the same scale may be used for, COMPOSIT signals, i.e. picture plus blanking and sync, VIDEO ONLY signals with blanking but without sync pulses or SYNC pulses only.

In practice it has been found advantagous while retaining the basic features of the aforementioned scale, to add certain markings that facilitate the measurement of video levels. There are three commonly used scales. Scale A is used most often for camera control scopes where you are interested in the video and not in the sync. This is often called a camera shading scale since it is only used to monitor the video, which is what you are adjusting to obtain an optimum picture with a camera. You will notice that the scale starts a zero and runs to 120. The blanking, black and white reference levels are indicated. Since there is a small level difference maintained between blanking and black reference, usually 7.5 or 10 IEEE divisions, it is so indicated on the scope graticule. In addition to the scale along the left hand edge (which is standard practice) there is an added series of horizontal lines corresponding to the scale divisions which extends across part of the screen area facilitating measurement of signal peaks wherever they may occur along the time axis. Furthermore, the reference white and reference black lines are heavier than most of the others and extend completely across the graticule. The blanking level is also indicated by a heavy line that is broken in the center (as the thin lines corresponding to the remaining scale divisions) to facilitate observation of blanking signal waveforms.



Calibration scales for use on waveform monitors: (a) for camera-control units where only noncomposite (i.e., picture plus blanking) signals are encountered, (b) for line monitors where composite signals are usually handled, (c) for transmitter waveform monitors where the percentage modulation is also of interest.

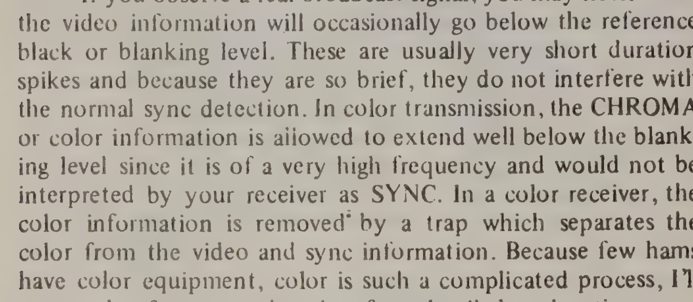
For use with waveform monitors that display composit signals, the scale just described is supplimented by the addition of markngs below the zero or blanking level point as shown in scope display B. A scale of this type is useful for monitors located in master control rooms on incoming and outgoing lines and at other locations where a composit signal is handled. On this scale the sync level that has been standardized by practice is shown at the -40 point and is suitably labeled.

Finally, for use on waveform monitors at transmitters, the scale shown in C has proved very useful. Here the zero or blanking level is shown to corresponde to 75% modulation in accordance with FCC regulations. Likewise, the sync pulses are indicated as being at the 100% modulation level, and the white reference level is indicated as 12.5% modulation. FCC regulations specify that the white level shall be 15% or less of the carrier amplitude.

While the actual signal level in volts could be almost anything, the scale and the portions of the amplitude and the ratio of sync to video should remain the same. In standard practice, the peak signal level is usually 1 volt, with .707 volts of video and .293 volts of sync.

If you observe a real broadcast signal, you may notice that the video information will occasionally go below the reference black or blanking level. These are usually very short duration spikes and because they are so brief, they do not interfere with the normal sync detection. In color transmission, the CHROMA or color information is allowed to extend well below the blanking level since it is of a very high frequency and would not be interpreted by your receiver as SYNC. In a color receiver, the color information is removed by a trap which separates the color from the video and sync information. Because few hams have color equipment, color is such a complicated process, I'll reserve that for some other time for a detailed explanation.

In general practice, the black levels are maintained at 7.5 or 10 divisions above the blanking level. This is to keep the black information from being clipped in the sync separator of your receiver, and provide a lower level for the blanking of the retrace, so the beam in your TV receiver is extinguished completely during the retrace time. A circuit in your TV receiver called a DC restorer, will hold the black levels to this predetermined level, otherwise, you would have to readjust the brightness each time the scene changed.



Noise pulses are little pulses of energy, a signal. Since what we most easily see is a brightening of an object, white noise would be more objectionable than black noise in the picture. In the transmissing process the picture is electronically inverted, that is, the white objects are the lowest transmitted levels, and the blacks are among the strongest, and the sync pulses are the strongest. Since it is the sync pulses that hold your picture stable, you would want them to be the most immune to noise which is also received. So the sync pulses have the most power. Thus they are able to override or mask the noise or provide the best signal to noise ratio in weak signal conditions. With the sync having the most power, your set can best ignore the noise which might otherwise produce an unstable picture in weak signal conditions. This is why you may be able to see "sync bars" when you cannot actually discern a picture on the screen of a very weak signal.

This is called a negative transmission, in that while you normally consider a picture which has white elements as a positive image or the highest level, in transmission, the white have the least power or are negative. Don't worry, your receiver sorts this out and produces the positive picture you are accustomed to. Because a white area adjacent to a black area tends to visually diminish the size of the dark area, a normal ocular phenomenon of your eye and the nature of the electron beam in a picture tube to spread over an area larger than is actually energized, noise pulses, which are in a sense black picture elements are masked to some degree in the negative transmission mode. Also, because the stronger the black pulse, the more apt it is to be "above" or "below" the blanking level (depending on how you interpret your directions at this point) it is more likely to exceed the blanking level of the signal, and thus make itself "invisible." If it were the other way around, the stronger the pulse the "whiter" the signal; the white flecks would be much more noticable since they could be brighter than the scene. Since you cannot reproduce "blacker than black" on the picture tube, the black noise is less objectionable. This may seem a little confusing, but remember that in transmission, the blacker than black levels are below the blanking level. Any signal which is below blanking is "blanked out" and is not produced on the screen. In other words, the signal extinguished itself!

Since the blacker the image, the stronger the signal, you should easily recognize that the black signals are more easily transmitted with more range than the white signals. To get more range, you need more black picture elements. Truly, in TV signal range, black is beautiful!

Now, the black picture elements have more energy than the white picture elements. If you look at a normal scene, you will easily recognize that most objects you see are dark against a light background. You do not normally interpret a scene as a light object against a dark background, or white on white. Most scenes are of reflected light from objects darker than the light source. In nature we see in reflected light. Light which is darkened or colored by the object we are observing. We do not often look directly at the light source. This is probably the opposite of how you previously thought you looked at the world around you. Perhaps its easier to understand with a few examples. The only objects which EMIT light are light sources such as the SUN, stars, and luminous objects such as the hot wire in light bulbs. Everything else you see, the MOON, the dog house, cars, people, trees, are seen by the light they REFLECT to your eyes. Trees and houses and people do not EMIT light, the REFLECT light. That's why you cannot see as well at night as you can in the day. There is less light to be REFLECTED, so everything is DARKER! You might say that you are living in the dark most of the time! Darkness is the light of life! You see many more illuminated objects than luminous objects. Likewise, if you look at the waveform of a television signal, you will see this depicted in that there is much more black and gray information than white information. A graphic representation of the real nature of a natural scene. This is the normal view of things, the exception would be a picture of the sun or a headlight. This is not only hard on your eyes, but hard on the TV camera tube as well!

In AM or amplitude modulation, the stronger your signal, the louder it sounds. In TV, the stronger the signal, the blacker

it is. This is NEGATIVE transmission. In HAM TV it is often desired to increase the average modulation, or make your signal "louder" by making it blacker. If you were to squash the whites, you would lose the picture contrast, and this would only result in a washed out picture: Something to be avoided. If you were to squash the blacks, much of the detail in the picture would be lost, which you do not want to do either. To increase the signal level of the blacks without destroying the black to white ratio, you reduce the amplitude of the sync. You compress the sync SLIGHTLY, never more than by half, which would bring your blacks to a higher power level. This would increase your average picture power, and help your signal in weak reception areas. This is not done commercially, since the broadcaster desires to produce the optimum picture at all times. If you are interested in DX, you can sacrifice some picture quality to extend your range or make a difficult picture easier to decipher. Its somewhat like turning up the contrast control in the receiver, by providing a little more signal to produce a picture in the video circuits.

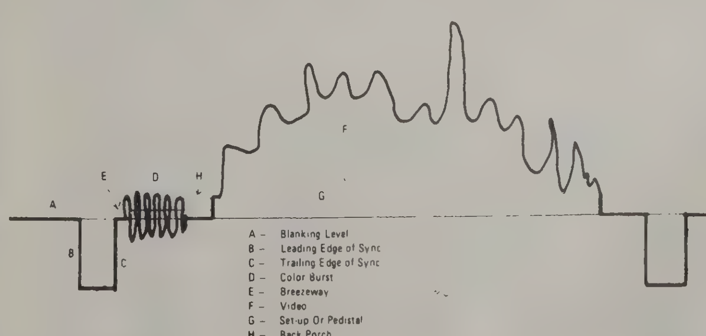
If you already have a TV transmitter, you can demonstrate this for yourself. Connect a power meter to the transmitter output. Now focus on a bright scene and observe the power output. Now, cap the lens. See the power go up? A real demonstration of black power!

Now that I've covered the entire signal, let's take a closer look at the sync portion of the video signal. There are two basic scanning systems, called INTERLACE and RANDOM. As you recall I explained that in broadcasting, in order to reduce the flicker, a system called INTERLACE scanning was used in which you first scanned all the odd and then the even lines in the picture. In order to move the scanning electron beam in a precise manner, so that the ODD and EVEN lines are INTERLACED properly, some extra time must be spent to shift the beam from the left of the screen to the center of the screen. Otherwise, if the beam started at the exact same spot for each field, they would overlap, and not be inbetween the lines previously scanned. This inbetween scanning is the interlace of the two fields into one frame.

To hold the vertical scan time a little, to allow the horizontal scan to run half way across the screen, some extra pulses called EQUALIZING pulses are added to the vertical interval. Their only purpose is to cause this slight delay, about 31 usec, the time it takes to scan half of the line. These are half the time of a regular horizontal pulse, specs call for a 2.4 usec pulse. There are six to each field, three before and three after the vertical pulses. If you remember the pulses seen on the misadjusted screen, these are the little "hammer head" pulses seen. TV monitors are often built with a circuit which delays the horizontal and vertical signals to produce a picture called PULSE CROSS, which allows you to observe the pulses. A graphic representation of this is on the following page.

In inexpensive cameras such as you and I use for HAM TV and many found in use in non-broadcast applications, a system called RANDOM interlace is used, mainly because it is cheaper to produce. While it takes an expensive SYNC GENERATOR to produce the exactly timed pulses required for broadcast use, called NTSC or RS-170 sync, our applications are less demanding. What we require is a simple system which will produce a reasonably stable picture. Since the 60 Hz (or 50Hz) power from the wall socket is basically stable enough for our use, inexpensive systems use it to establish the vertical rate of sweep in the camera, and use a free running, or sometimes, quartz oscillator for the horizontal sweep rate. Because there is no direct relationship, no synchronizing, no reference in common between the horizontal and vertical sweep circuits, the alternate fields may fall inbetween each other, on top of each other or anything inbetween in a RANDOM manner. Thus, random interlace. In a sync generator the pulses are precisely timed and sequenced. In our cameras there is no precise sequence, and we may have 525 lines, 520 lines or just about any other number within some tolerance level of 525. It's not unusual to have a camera with random sync to vary from 475 to 600 lines per frame with a variance in temperature or operating voltage. From this you should see the obvious advantage of a sync generator in terms of stability, and increased vertical resolution.

For the sake of introduction, the following diagram presents a few more terms you are likely to come across in television. While terms as front porch, black porch, breezeway, burst and the like are used with frequency in broadcasting, (and apply to your signal as well) they are less common in the day to day operation of your HAM TV station. The object of this book is to get you on the air with enough knowledge to make it easy, successful and FUN, not to educate you in all the aspects of TV. If you have greater interest in TV signal technology, I would suggest the **National Television System Committee** by McGraw Hill. That book was the basis for the American system of broadcasting as we know it today. It covers in depth and detail the technical considerations for all the video signal components.



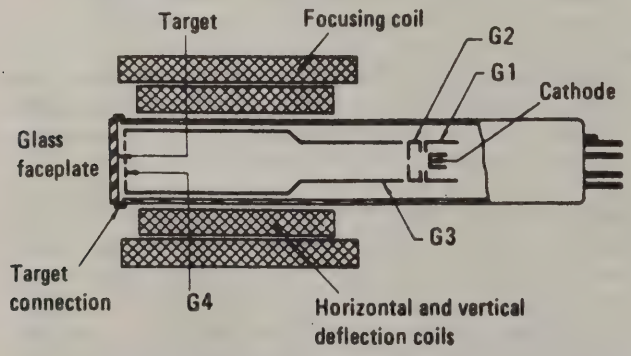
CHAPTER 4
CAMERAS AND LENSES
BASICS

No single piece of equipment seems to baffle the video neophyte more than the camera and lens. Perhaps this is because as HAMS we are familiar with transmitters and receivers, but are not often well experienced with TV cameras. Often not understood is that the camera and what and how it sees determines how your pictures look to the folks on the receiving end of your signal. Your transmitter may be capable of sending a good clean picture, but if the camera does not produce a good picture, your efforts are unrewarded. The camera and lens are the EYES of your ham TV station just as the microphone is the ear.

Almost everything you see on your TV set has been seen by a TV camera first. To know how it works and how it produced pictures will enable you to utilize your camera best and produce the kind of pictures that will have your QSO's as enjoyable to watch as they are to send.

There are three main parts to your camera. The lens, which selects the field of view and produces a small image of it on the face of the pick-up tube, the camera pick-up tube and the electronics of the unit.

The camera works the same no matter who made it or what kind it is. The difference between different cameras, and between color and black and white cameras are in the number of parts and how it was assembled. The principles of operation are the same. To whit, light, which is reflected from an object passes through the lens. The lens forms an image of the object on the face or TARGET of the camera image tube. This image is scanned by an electron beam controlled by the horizontal and vertical sweep circuits of the camera. The signal generated in the tube is amplified by a high gain amplifier and is mixed with the sync pulses from the sweep circuits, and is presented at a connector as a composit TV signal.



The signal starts at the TARGET where the electronic charge produced by the light striking the photosenstive surface of the target, is scanned by the electron beam. This signal is brought out of the tube by the target connection, usually a ring located near the front of the tube. This tiny signal is amplified, and in some cameras certain inherent errors are corrected. The camera generally amplifies the signal until there is about .7 volts of video. The sweep circuits produce the sync pulses (unless your camera uses external sync from a generator) which are electronically added to the video signal to form the composit signal. This composit signal is then delivered to the video output connector. Some cameras also have a built-in RF generator. If so equipped, the signal can also be routed to the RF generator where it is used to modulate the signal. The generator usually has an output in the low VHF channels of 2-6.

CAMERA TERMINOLOGY

Most of the cameras hams and video hobbyists use are self-contained. That is, all the electronics is in the same box as the pick-up tube. More sophisitcated cameras have some or all of their electronics located away from the pick-up tube and lens assembly. Sometimes the external electronics are mounted in a rack panel, or in a tag-along box at the end of a length of cable. In either case, the electronics is called the CAMERA CONTROL UNIT or CCU. The part of the camera with the pick-up tube and lens is called the HEAD. Together (whether the pieces are separate or together) the various pieces are called a CAMERA CHAIN.

Again it is necessary to learn a little of the language of television. BURN IN or STICKING, is the after-image of a scen scene which remains visable even though the camera is directed into another direction. This after image is often a dark or negative image of any bright object which was previously in view of the camera. If you were to direct the camera at the sun, or a bright light for a period of time, the image can be permanently burned into the photosenstive surface of the tube, and will remain long after the camera is moved. The dark image or silhouette can remain for the life of the tube, which is why it is not a good idea to ever point your camera at a bright light or the sun. If the after-image lingers for only a short period of time, the problem may not be serious. If it seems to linger for quite a while, and the light was not bright, the tube probably is old and needs to be replaced. Image Orthicons, a type of camera tube, were much more susceptible to this problem than vidicons or other types of tube. In older I0 cameras, a mechanical device called an ORBITOR was used to physically slowly move the image over the face of the tube in a slow pan and tilt fashion to prevent any bright object to be on any one area of the face of tube for any period of time. Modern cameras do not require the use of an orbitor since the tubes used today are not as "sticky" as the older 10's.

CONTRAST RATIO. The contrast ratio is the ratio of black to white. The camera tube cannot accept as large a contrast ratio as your eyes. As a consequence a scene in TV black and TV white is not as dark or as light as your eyes would see the scene. For good pictures, the ratio, expressed in foot candles, would not be more than 20:1. In general you should have an even amount of light and avoid dark shadows in your picture. In your ham shack, a few extra lights will often clear up any problem in lighting your TV QSO's. Remember, even though the light may look good to your eyes, the camera amplifies the differences and so is much more sensitive to modest differences. Uneven lighting will cause your picture to have dark edges or sides. This is called, of course, shading. While sophisticated cameras have shading controls to correct for poor light conditions or uneven distribution of light, it is much better to have an even distribution of light. The camera shading controls vary the amount of gain from side-to-side or from top-to-bottom, but this can also introduce noise in the picture in areas which are too dark. If you only have a single light near the center of the scene, all the sides will be darker than the center, and the effect is much like looking through a tunnel or port hole, and is called portholing. By the way, an even light in the shack is better for your eyes as well as your camera.

LAG. If you do not have enough light for your camera, the picture will lack contrast. Even if you open the iris all the way, you may still have a washed-out picture. An easy way to determine if you have enough light, (many lenses do not have an iris so you can't read the F-stop to check the light level) is to move the camera in a pan or tilt fashion. Pan is side-to-side, tilt

is to raise or lower the lens relative to the camera mount. If the images seem to trail behind the motion, or stick, you do not have enough light. This trailing image is called LAG and if you have bright objects in a dark room, a long trail may be seen as you move the camera. (To boom up or down means to actually move the entire camera and mount up or down, without necessarily tilting the camera from a level atitude.)

Because TV black and TV white do not correspond to what our eyes see as black and white, a scale was devised to adjust the camera controls. The scale, called a GRAY SCALE, is a series of squares ranging from TV black to TV white in logrithmic steps. The scale has 5, 7 or 10 steps. TV black corresponds to a reflectance of 3% while TV white corresponds to a reflectance of 70%. (for color, TV white is 60% reflectance since color is made of three distinct hues – red, green and blue, none of which is 100% reflective) Because the camera tube responds to changes in light at the dark end better than it does to changes in light level in the bright end of the scale, the 50% reflectance is not in the middle of a 10 step chart, but is actually step two! This is because it takes relatively little light to produce a dark or even a medium gray on a monitor. The mid-step of the 10 step chart, step five is actually only 18% reflective. Television cannot reproduce pure white (100% reflectance) or pure black (0% reflectance). You will find that most television systems reproduce only seven distinct steps of gray between TV black and TV white. The seven step gray scale, therefore, is often preferred as the more realistic guide to camera operation. (This is also why in slow scan and similar digital video systems, only eight levels are reproduced.) Your camera should be able to reproduce at least five of the steps, and a good camera will reproduce seven or more.

If you look at the signal on an oscilloscope, you may notice that the steps are not equally spaced. The dark steps may be closer together than the white steps. This is typical for an inexpensive camera. The change in size of the steps is called the falloff. A camera which has a fast falloff, will compress the dark areas and make slightly dark areas equally dark. A camera with a slow falloff, will produce equally spaced steps corresponding to the steps on the chart. Because a camera's signal is the smallest during the scanning of a black object, the noise in the camera is greatest in the blacks, the signal to noise ratio of the picture is the least in the dark areas. A camera which has a fast falloff rate, will have a poor signal to noise ratio since it makes a picture artifically darker than it really is, and distorts the contrast ratio of objects between the TV black and TV white levels.

RESOLUTION. Resolution is how fine of a detail the camera can reproduce. On the next page is a resolution chart used to adjust a TV camera. You will observe that it has several different patterns. There are a number of areas which are composed of converging lines or wedges. These are resolution wedges. There are four large wedges radially around the center of the chart, and in each corner, a smaller circle with similar wedges. If you read the specification sheet of a camera, it lists the resolution as so many lines at the center of the picture. For an inexpensive camera this would be between 400 and 500 lines. This is the horizontal resolution of the camera. Vertical resolution is determined by the number of lines in the scanning system used. In a random scan camera, the verticle resolution is about 250 lines. If you adjust your camera so that the resolution chart completely fills the picture, you can read the resolution directly from the chart. The horizontally oriented wedges are to read VERTICAL resolution (number of elements in one vertical scan) while the vertically oriented wedges are used to read the HORIZONTAL resolution (the number of horizontal elements in one scanning line). Focus and adjust your camera as per the instructions provided by the manufacturer, and you can then read the number next to the point where the lines are no longer distinct but tend to merge into a medium gray. Whil While adjusting the focus controls of your camera, you adjust for the highest, best, resolution. The corner circles and wedges are to monitor (adjust if possible) the linearity and resolution of the camera in the corner. Generally, a camera will have its BEST resolution in the center of the screen, and about 1/2 the amount in corner resolution.

When adjusting your camera controls for best focus, you should turn the brightness of your monitor down. Otherwise you may mask the resolution of your camera by the resolution of your monitor. A good TV monitor should have no problem reproducing as much as 1,000 lines resolution, even though your camera won't come close to that. A converted TV will not be able to do as well, and if you are using the RF output of the camera to the tuner input of a TV, the resolution will be restricted to the ability of the RF modulator, TV tuner, TV IF, and the filters in the receiver video system. Generally, only about 200 lines of resolution are able to be reproduced in the RF mode.

With your camera set up on the test chart, and with a good light, adjust the beam, target and focus controls. Carefully adjust the iris and lens focus for the best possible picture. (Following the instructions supplied by the manufacturer) If you do not have the directions, don't worry, I'll explain how to do it a little later. Your beam and focus controls may have a little interaction on inexpensive cameras, so a little care here will result in better pictures later. The beam focus control, or electronic focus (vs. the lens mechanical focus) control is best adjusted now, and then not disturbed unless the tube is changed, or the age of the tube is well advanced.

If you have an oscilloscope, connect it to the video output of your camera. Adjust the oscilloscope for a line rate display as we depicted earlier in the book. You can adjust the scope gain controls for a good display of the signal video and sync. The video should be about 2.5 times the amplitude of the sync (100 to 40 IEEE divisions) and the trace should be aligned so the blanking level is coincidental with a convenient graticule line of your scope. The target control should be adjusted so that the black images are just above the blanking level. The black peaks should be at the black reference level, about equal to 1/4 of the sync amplitude. The lens should be adjusted until the whites are equal to 2.5 times the sync amplitude. Now, adjust the beam control until the white peaks are just beginning to be clipped. This is the best beam position. More beam will reduce resolution, and less beam will not fully discharge the white areas of the picture. Carefully adjust the beam focus by rocking it back and forth, while watching the vertical wedge which starts near the center of the chart and runs toward the top. Stop when you have the best resolution. You are now ready to make beautiful pictures!

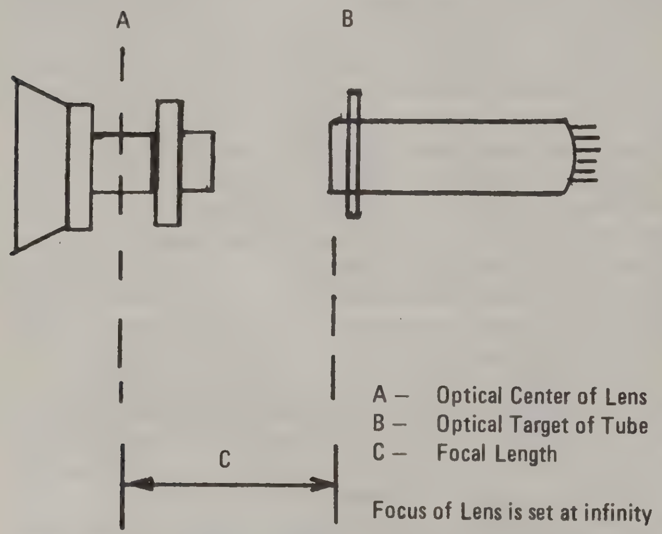
LENSES AND TUBES

The common garden variety camera such as you and I are likely to own uses a vidicon pick-up tube. The face of the vidicon is either 1" or 2/3" in diameter. Common types would be the 7735, 7038, HS 200, HS 202, etc. With modern electronics, the tube size is not important in inexpensive cameras. High quality broadcast cameras have additional electronics which can enhance the ability of the larger tubes which our cameras are not capable. For our hobby applications, either size is good enough to provide pictures with a level of quality, definition

and clarity adequate for our TV systems.

One of the important things to remember is that the image size made by the lens has to be smaller for the 2/3" tube than for the 1" tube for the same field of view. In other words, the same lens will produce a picture of different sizes on the various tube sizes.

For instance, a camera with a 2/3" tube uses a 16mm focal length lens to reproduce the same scene that a 1" tube does with a 25mm focal length lens. If you put the 25mm lens on the 2/3" tube, you will get a telephoto image, while the 16mm lens on the 1" tube will produce a wide angle effect. A wide angle lens for a 2/3" tube is 8mm. The 1" telephoto lenses would be of 50, 75 or larger focal length. While you can change the scan size of the camera which has a 1" tube to obtain the correct field of view with the lens made for the camera that has a 2/3" tube, the reverse is not true. You can, however, just be content with the field of view and save some money by purchasing any lens which will fit your mount, and not worry too much about the image size.



The focal length of the lens is the distance from the center of the lens optics to the front surface of the tube expressed in millimeters, when the lens is focused at infinity. A short focal length lens has a wide field of view, and a long focal length lens has a narrow field of view. A lens which has a variable focal length is called a ZOOM lens. A zoom lens can be set at an infinite number of focal lengths between the extreme ends of wide angle and telephoto. Now look at your lens. Does it have an adjustable iris? On your lens there are probably two sets of numbers. One is on the focus ring which indicates at what distance the object is in focus, the other is on the iris which indicates how much light can pass through the lens compared to size of the lens. This is called the F-STOP. When talking about a lens, usually the F-stop is mentioned at its maximum opening. Most lenses have an iris that can be adjusted to a small opening of F 22 or so. The wide open setting varies with the quality and size of the lens. A lens with a maximum F-stop of F 2.8 will not let as much light through as a lens with a maximum F-stop of F 2, or F 1.4. The F-stop is a carry over from photography. With film, the shutter speed is well as the iris can be adjusted. With a TV tube, only the iris can be adjusted since the "speed" is a function of the scanning rate. Camera tubes do have a "speed" rating, but it is of little consequence to this discussion. A fast lens would allow more light through for a faster exposure of the film, thus a FAST lens has a low F-stop number indicating that it does not restrict much of the light from the object. A SLOW lens would have a high F-STOP number, say F 4, or F5.6, and is more restrictive, it lets less light through. A difference in 1 F-stop is a difference in light level of 1/2 or 2, depending on which way you go. If you open a lens from F 22 to F 16 you double the amount of light passing through the lens. If you stop a lens from F 4 to F 5.6, you reduce the amount of light by one half. Even the most inexpensive lenses will have several F-stops of adjustment to allow a large ratio of light from open to closed. Generally, the better a lens is, the lower its F-stop will be, and the "faster" it will be.

Under most lighting conditions, an average lens is all that is necessary. If you are using the camera under predominently low light levels, you may find that you are operating with the iris all the way open and still do not have a good contrast ratio. This indicates that you need a faster lens. A good fast lens would have an F-stop of less than 1.4. In terms of video level, 1 F-stop is equal to a 50% change in videl level. A scene which has the white peaks at 50 IEE divisions, would have the white levels at 100 IEEE divisions if you opened the lens by 1 F-stop, say from F 8 to f 5.6. This is equal to a **3db** change in the video level.

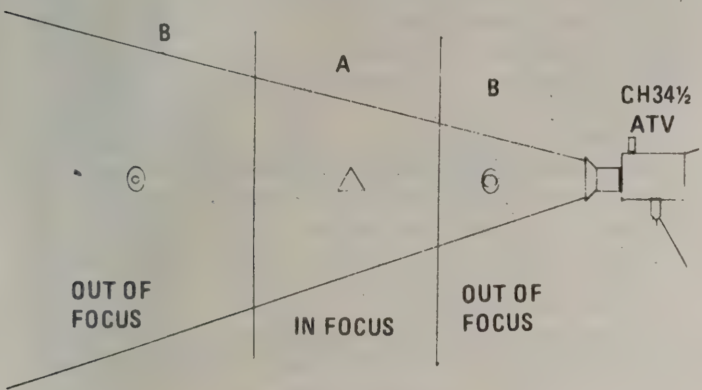
As you use a lens with a larger than normal focal length, say a 75mm lens vs. a 25mm lens, you will notice that the minimum F-stop generally gets larger. This is because as the field of view shrinks, becomes less and less, the amount of light available is less, so the effective F-stop or speed of the lens is decreased. You can have a low F-stop, or a high speed telephoto lens, but the front element of the lens becomes very large very quickly in order to gather in enough light to increase the speed of the lens. That is one reason why a telephoto lens of F 4 costs a lot more than the same focal length lens rated at F 8!

A zoom lens is generally expensive, but its like having a lot of different lenses. It will generally not be as FAST as a normal lens. A zoom lens has an additional term called zoom ratio. The ratio of a zoom lens is the ratio of the focal length when set at telephoto to the focal length when set at wide angle. Common zoom ratios are 5:1, 6:1, 10:1 and 18:1. Most inexpensive zoom lenses have zoom ratios of less than 5:1. Some zoom lenses of dubious quality have a zoom ratio of only 2:1. The zoom ratio of a lens is easily determined from the focal length numbers. For instance, if a lens is rated as being variable from 14 to 70 millimeters, the zoom ratio would be 5:1. Since it is difficult to produce a quality lens which will focus over a large range of focal lengths, a good zoom lens is expensive. Larger zoom ratios than 5:1 are also more difficult to produce, since you need to be able to maintain good focus over the entire range, and as such, the larger zoom lenses are also expensive. You can check the quality of the lens by using the resolution chart. Set up the camera and adjust the zoom lens for maximum wide angle, and carefully focus the lens. You will probably notice a decrease in the resolution from what you normally can see with a fixed focal length lens of the same focal length. Ie, compare a zoom lens of 14-70mm with a fixed lens of 14mm.

The zoom ratio also expresses the field of view. If your camera can cover a field of view of 20 feet at a distance of 20 feet from the camera, when you zoom in with a lens with a ratio of 5:1, the field of view will be reduced by 5 to 4 feet at the same distance of 20 feet.

Some zoom lenses also have an accessory lens called a range extender. These DO NOT increase the zoom RATIO. They increase the focal length of the lens by the factor stated. A 2X range extender will change a zoom lens rated for 14-70mm to a zoom lens of 28 to 140mm. The ratio is still the same (5:1) but **both** the wide angle and telephoto focal lengths (and everything inbetween) has been doubled.

Another important aspect of the lens is the depth of field. If you have a photographic camera, say a 35mm format camera, you will notice a set of numbers adjacent to the F-stop numbers which indicates the depth of focus for each F-stop. The depth of focus for any particular F-stop is the distance from the nearest object to the farthest object that will be in focus. As the iris is adjusted to a smaller size (larger F-stop, say f 11, 16 or 22) the depth of field is much larger. Usually at F-stops of F 22 or larger (smallest lens opening) the depth of field is from a few inches from the camera to infinity.



DEPTH OF FIELD Fig 23

You can use this to your advantage if you desire to focus attention on an object near to you. You would focus on the object with a low F-stop and the background would be out of focus. You can then vary the point of focus to bring other objects farther away into focus, until only the background is in focus and objects near the camera are out of focus. You can even see through some objects which otherwise might block your view in this manner. Screen doors and rain splattered windows, if very close to the lens, can be so far out of focus that you actually focus-through, and have a view of what is beyond. You can do this with your eyes when your focus on the door screen, or look beyond it and focus on a more distant object. You selectively see what you want to see.

If you use a wide angle lens for close-up pictures, the angle of view will tend to distort the picture. The object near the center of the field of view will be artifically larger than objects off center. This can be used as an effect, to make facial features disproportionately large or to make ants as big as cars in the same picture. This is a form of macrophotography often used in commercials and science fiction movies to make monsters of otherwise small animals.

On some cameras you will also have a mechanical focus knob. The purpose is to vary the distance between the lens and the tube. It normally moves the entire tube and deflection coil assembly. This is often called the back focus. The mechanical focus is used when you cannot easily reach around to the front of the camera to focus the lens in the normal manner, and with zoom lenses.

If you have a zoom lens, you would adjust the focus as follows: Zoom the lens all the way back to provide a wide angle view. Now adjust the back focus. Now, zoom all the way in, and focus the lens focus control on an object which you desire to be able to zoom to. Your lens will now be in focus for the entire zoom range from wide angle to telephoto to any object which was at the same (or nearly so) distance as that which was used to adjust the front (lens) focus. If you move the camera you will need to re-establish the back and front focus points. A good studio camera operator can frequently focus as he zooms from object to object.

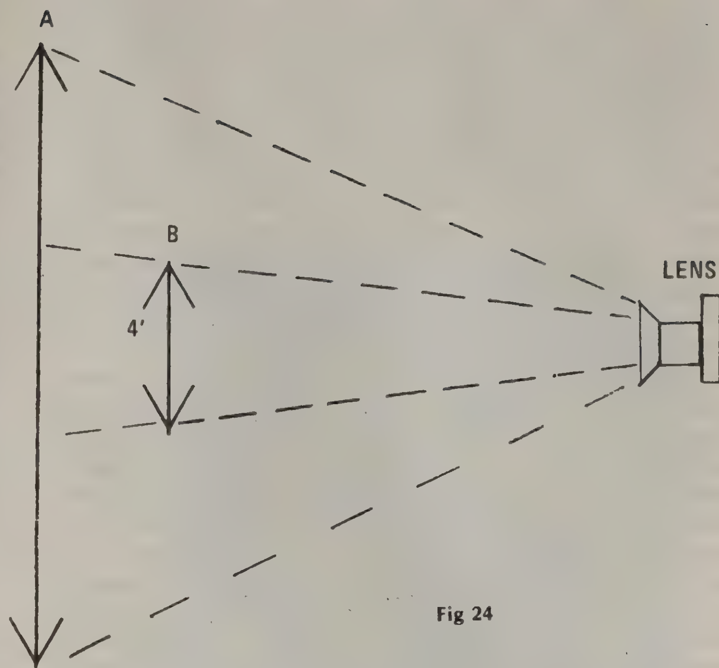


Fig 24

If object A and object B are equally distant, this diagram represents the field of view of a zoom lens with a zoom ratio of 5:1. Wide angle might be a focal length of 14mm and the telephoto focal length would be 70mm.

Lens angle (horizontal field of view) for a 1" vidicon 'C' mount lens

size	angle	field of view 10' from lens (feet)
15mm	45°	8.2
25	28°	5
55	14°	2.5
75	9.5°	1.5
100	7°	1.1
150	5°	.85
225	3.2°	.55
300	2.4°	.4

Lens resolution and lens nomenclature can be somewhat confusing. In the American scanning system, the vertical aspect of the picture is divided into about 525 lines, each running horizontally, left to right. In essense, 525 individual strips of video laid next to each other in parallel fashion. This limits the vertical resolution to the number of active scanning lines. There is no way to reproduce an object which would have more detail than the number of resolution elements (lines) in the picture. Horizontal resolution though, is not so limited. The limiting factors are the optical quality of the lens, the image size/scanning beam size, and construction of the pick-up tube, and the frequency response of the tube and electronic amplifiers which process the signal.

Even an inexpensive camera can reproduce a great number of discreet points on any one scanning line. If the camera is carefully adjusted, the resolution can easily be 500 lines or more of resolution. The quality of the lens is more restricting than the electronics in inexpensive cameras. The cheap lenses just cannot form a clear sharp image as well as a higher quality lens. A really good camera will show this even more readily.

Some of the lens qualities that restrict its resolving ability

are the accuracy of the curvature of the lens elements, the surface smoothness, quality of the anchromatic coating, accuracy of the lens element alignment, and tracking of the lens elements which move to change focus or focal length.

Nearly all lenses used for TV cameras consist of more than one piece of glass. Each glass piece is called an element. In most lenses, there are several elements, often ranging into the teens in number. Each element must be in exactly the correct position in relation to the elements before and after, in order to pass on a correctly defracted image. If the element is not in the correct position, or is tilted, or out of round, the image will not be defracted or bent, the same over the surface of the lens. This results in a fuzzy and out of focus image. The lens elements must also be on the same optical axis, the centers concentric with each other, otherwise distortions and aboritions will result. The surface of the glass must be smooth, any coatings applied to add color correction (anchromatic) must be of the same thickness, consistancy and opacity. Any lens element which must change position must be held ridgidly in alignment during its entire length of travel, and cannot be loose or free to move in any but the desired direction. Finally, the glass cannot have any imperfections or bubbles! Many inexpensive lenses are easily knocked out of alignment by shock, such as being bumped or dropped. A poorly finished lens element can scatter a portion of the light of the object, causing light flares. A good lens has a special coating to reduce light flare. Even the formula used to make the glass in the lens will affect the quality of the lens and the image it produces. Needless to say, any compromise or error in the care taken to make a lens will reduce its ability to produce clear, sharp images. A good lens is not cheap!

Even the iris position, and number of blades will affect performance. At small iris openings, the light passing the edge of the iris is refracted, much like a defraction grating, and produce a rainbow-like edge to high contrast changes in the scene.

In photography, a lens resolution is expressed in line pairs per millimeter. A line pair is a black line of a given eidth and the white space next to it of the same size. In TV the calibration is in lines per inch or lines per inch of picture height. In TV both the black and white lines are counted. The formula to convert photographic resolution to TV resolution is: TV lines = (25.4 x .375 x 2) x (photographic resolution).

To save time, this reduces to: TV lines = 19.5 x photographic resolution. The conversion from millimeters to inches is 25.9. The .375 is the picture height in inches on a 1" vidicon tube. The 2 is the line count factor because we count black and white lines, not pairs of black and white lines.

On a TV resolution chart, as shown earlier, all the work is done for you. All you need to do is to fill the camera field of view with the chart and determine where the wedges can no longer be discerned as individual lines. That point is compared to the adjacent scale, and the result is the resolution of your camera system.

Lens formats.

If your camera uses a 1" or 2/3" tube, it is also in all likelihood equipped with a C or 1" mount. A 'C' mount is 1" in diameter, has 32 threads per inch and is commonly found on 16mm film cameras. It is often referred to as a 16mm format lens. The distance from the front flange to the face of the tube is .69 inches.

If your camera uses a 1/2" vidicon tube as do some mini cameras being imported today, they have a 'D' mount. This is the same format as on most 8mm and super 8mm cameras. The 'D' mount is .625 inches in diameter, has 32 threads per inch and the focal plane is .484 inches from the face of the flange.

Some rules of lenses:

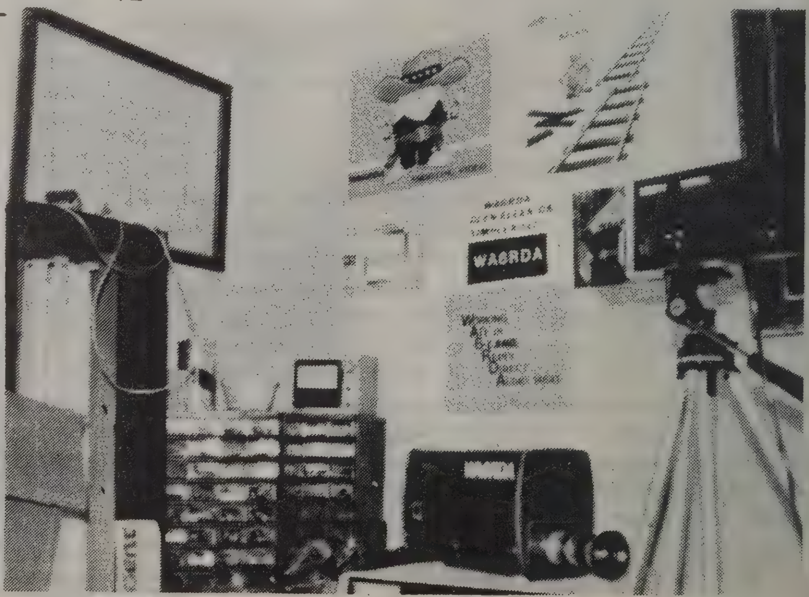
The longer the focal length is the larger the image size will be while the angle of view will be smaller and the less the depth of field.

The shorter the focal length is the smaller the image size will be while the angle of view will be greater and the depth of field will be longer.

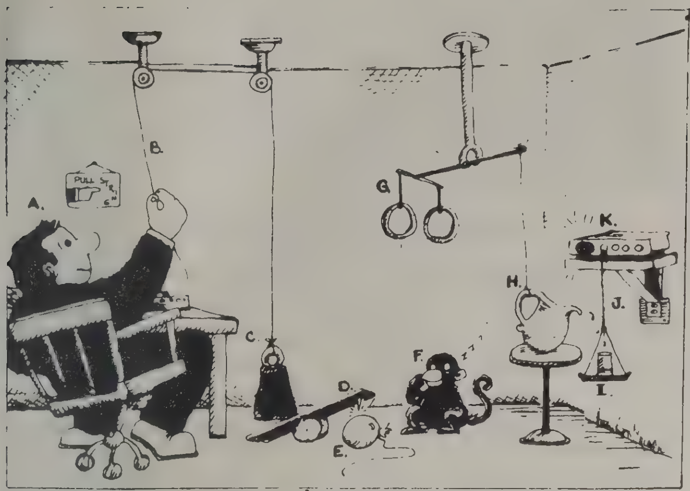
As the power or magnification factor increases (2X, 3X, etc.) the working distance decreases the lens diameter increases the field of view decreases and the depth of field decreases.

As explained earlier, the depth of field is the distance between the nearest object and the farthest object that will be in focus at any one time. The longer the focal length of the lens, the LESS the depth of field will be. The smaller the F-stop, physically (the numbers increase as the F-stop gets smaller) the greater the depth of field. Thus at F 22, the depth of field is much greater than at F 2. Finally, the greater the distance from the camera to the subject the greater the depth of field. If you use a close-up adaptor lens, you will notice that the depth of field may be only a fraction of an inch.

The following diagram is a basic camera system and visually summarizes this chapter. The power supply has been deleted for clarity. Now that you know how the equipment operates, the next chapter will cover how to use it and get good results, no matter what your investment.



STATION OPERATION



MR A. IS DIRECTED TO PULL STRING(B) LIFTING THE WEIGHT(C) WHICH LOWERS OTHER END OF PLATFORM WITH NAIL IN IT (D) CAUSING BALLOON(E) TO POP AND CUE MONKEY(F) TO JUMP UP AND REACH FOR RINGS(G) AND CAUSES OTHER END OF POLE TO TILT PITCHER(H) TO POUR WATER INTO GLASS(I). WEIGHT OF GLASS CAUSES STRING(J) TO TURN SWITCH ON RADIO(K) ON!
NOW MR A. CAN WORK EASILY AND KEEP INFORMED WITH HIS RADIO ON!

YOUR TV STUDIO

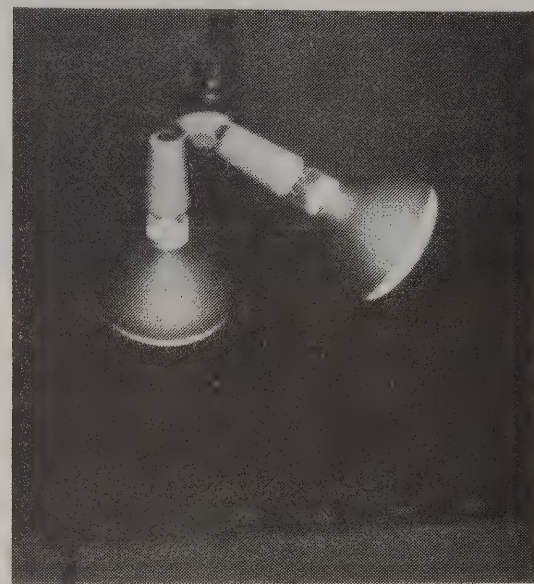
By now you should have a reasonable level of knowledge, a lot of ambition and perhaps some equipment. Now it's time to get on the air.

Since most beginning ATV operators do not have the knowledge or equipment to initiate full duplex operation, that is to send and receive simultaneously. You will probably receive and transmit sequentially. Further, you need to be able to get on the air with a minimum of problems and a maximum of success.

It is obviously necessary that your transmitter, receiver, converter and camera be in working order. The diagram on the first page of this chapter shows in block form, how your equipment is normally connected.

Some of the non-electronic props you should have on hand include a small easel. This can be a bulletin board or menu board on which you can put lettering to spell out messages. A copy of your QSL card can serve for your ID, or you can use a felt tip marker on cardboard to make your own ID card. You need a stable mount for your camera. A tripod as you might have for your 35mm film camera is fine, but often takes up a lot of floor space for the legs. If you invest in a cheap tripod of the less than $15 variety, you can remove the legs, and mount the head of the tripod on a convenient surface, such as your work bench. There are also ready made wall and ceiling mounts for cameras or you can make your own with a piece of pipe and a floor flange. In any event your camera should be mounted in a safe manner so it can not be accidentally dislodged and smashed.

The area of your ham shack which will serve as your studio should have a couple of extra lights. Two ceiling mounted 150 watt flood lamps such as those with the built-in reflector, are cheap and easy to use. A simple socket and mount will suffice. The back light can be a regular lamp, with the shade adjusted so that the camera does not look directly at the bare bulb. All lights should be out of view of the camera for best results. If you have your equipment on a work bench or table, then a florescent lamp on the wall directly above the equipment will help to lighten the shadows of the front lights. A simple light bar can be made from an L-shaped wood or metal mount about 2 feet long. Mount three or four ceramic sockets on the bar and wire them in parallel. The use of 75 or 100 watt bulbs is sufficient. An aluminum chassis or plate can serve as the reflector. You can fold the ends in a little to act as "barn doors" to direct the side light to the front. This can then be mounted on the top of your camera, so your light source follows your field of view.

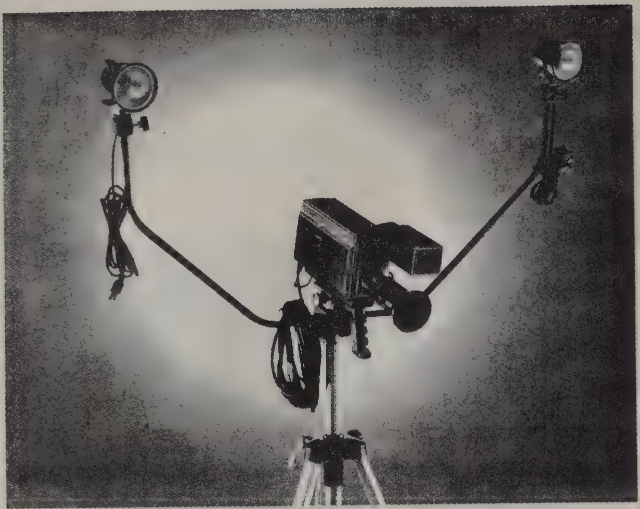


DUAL FLOODLIGHT ATV LIGHTING SYSTEM

A simple relay can turn on and off the lights with your transmitters "push to look" switch, saving on the electricity when receiving!

Lighting for your shack. All the lights should be mounted from the ceiling. The rear light can be directed towards the top of any equipment behind the subject, but allow the light to fall a little forward to lighten shadows from the front lights. The spot and flood can be reversed. The flood should cover the subject (you) and the objects which you normally intend to show on camera. The spot is to highlight the item of interest (you). Try and keep the same basic triangle arrangement in all lighting. The angle from the lights to the subject should not be severely vertical or you will have dark facial shadows. An angle of 30° or so is good (angle between light beam and level surface, i.e., ceiling).

Since all ATVers tinker with their cameras, you should have the test pattern handy, or mounted in a convenient place. If you letter in your call letters on the pattern, you can use it for on-the-air tests without an additional ID card. The art card display area should also be well lighted. A single flood lamp above and about 4-6 feet distant will provide fairly even light for cards of 10 x 15 inches or smaller. Larger items should have two lights, one from each side. For a small space a BALOP can be easily constructed. A simple card holder with two display case lights, usually 30 watts or so, one on each side, with an opaque shade on the camera side will do nicely. A simple one can be made from a single sheet of aluminum, the side facing the camera painted flat black and the interior facing the camera also painted flat black. A board can suffice for the bottom support.



Once you have your equipment set up and operating, you are ready for your video QSO. To be sure you are transmitting a picture, check your camera with your monitor, or if you can view your signal directly off the air (as a project later will allow you to do) and adjust your camera for a good picture. You can follow the guidelines in the previous chapter on cameras and lenses if you forgot how to do it.

If you have a wattmeter, you can indirectly monitor your video modulation. With no modulation, your transmitter should be at full power output. As you advance the video control, the output should drop because the duty cycle or average picture power will be less than your peak (sync tip) power. Normally the wattmeter will drop to 30%-40% when you have 100% modulation. If you started with 10 watts, a good beginning point would be 3-4 watts with video.

If there is another station on the air they can talk in your signal. If there are other ATVers in your area, hopefully you have already talked to them, and have decided on what frequencies to use for sound and picture. If not, fire up your TV rig on 439.25MHz, and fire up your two meter rig on the local repeater or simplex frequency of your choice, and bellow, "Hey, anybody around to receive a TV picture on 439?"

A5 MAGAZINE Editor Mike Stone WB0QCD MC's Fall Peoria Midwest Conference . .

ATV has been around long enough (more than 30 years) that someone in your area is, has, or wants to be on ATV. A little effort on your part will get the operators crawling out of the woodwork. In any event, don't be afraid to advertise the fact that you are on TV. Pass the word in your QSO's, at club meetings and local meets. If you announce your interest before you start building your station, chances are you will have a couple of buddies who want to get started also. Be sure to get them to buy a copy of this book!

SOUND WITH YOUR PICTURE

The sound signal is not always sent on the video carrier. In many areas of the country, the normal 4.5MHz subcarrier is used for sound. In the midwest, often 2 meter SSB or FM is used for the aural transmissions. In the Chicago area 144.34 Mhz FM is used with SSB operation For DX coordinators.

On carrier sound is the easiest to generate, since you use the converted FM rigs normal audio circuits for the audio, thus you are FM modulating the carrier with the sound, and AM modulating the same carrier for the video. For subcarrier sound, you need a 4.5 MHz FM transmitter, which is mixed with the video at the input of the transmitter, or for some modulators, a mix point is provided ahead of the final output so less carrier level (injection) is required for the subcarrier sound, while on carrier sound does not. On the receive end, you need to have a separate sound receiver or to convert the regular TV set to receive on carrier sound. Subcarrier sound is received in the normal manner by the TV receiver.

If you live in one of the metropolitan areas blessed with a TV repeater, the repeaters normally accept on carrier sound, but retransmit subcarrier sound so all you need is a normal TV receiver for video and sound reception, and a minimum of equipment for transmission.

Because there are so many ways to send the sound signal, many ATVers send more than one sound signal. For instance, you can use one of the sound channels can be used to send ANSCII coded signals from a typewriter, or RTTY or fax or SSTV while you send normal voice on the other channel and video on the main carrier. If you are experimenting with color, you can use the second audio channel to send coded information for field sequential color and other systems which you might experiment.

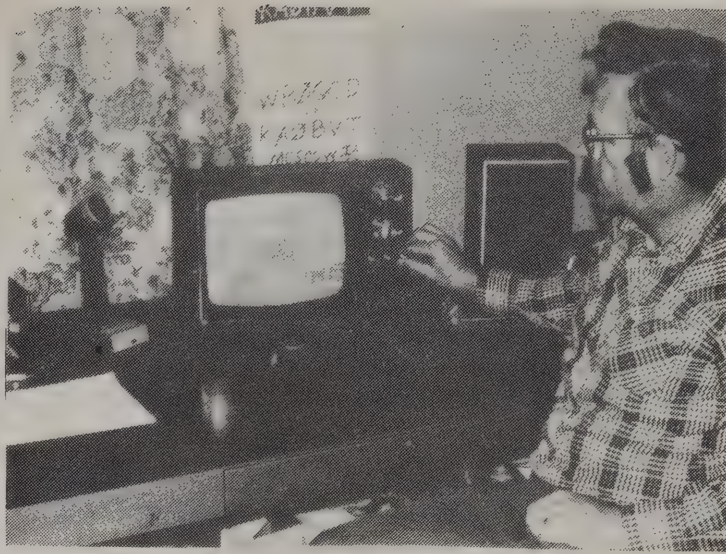
Video activity is generally on only a handfull of frequencies. The idea is to avoid any possible interference from other stations, and avoid producing any interference by your station. Generally, the carrier frequencies for ATV are 427.25, 436, 439.25. The TV repeaters use the first and third frequency for input and output. There is also activity on 1240HMz. If you have had experience on the 23CM band, then you might encourage activity in that band of frequencies.

A word or two on interference. Although your video signal has energy across a large portion of spectrum, typically 3MHz or more, the amount of power in the sidebands is very small. While the carrier level is measurable in watts, the sidebands are in milliwatts and microwatts. Nearly all the energy of your signal is in the first 1MHz of spectrum from your carrier. Only about 2% is spread over the remainder of the frequencies of your sidebands. Thus, the likelihood of your signal bothering anyone removed from your carrier frequency by more than 1MHz is very small. Also, you will be using a directional antenna, which further limits the area of possible interference. More likely than not, you will be bothered by TVI from the multitude of two meter FM rigs which are prolific in third harmonic signals which fall in the 420-450 MHz band. Your

strongest sideband is about 30 DB below your carrier level, and most of the sidebands are more than 50 DB below your carrier, while many 2 meter FM rigs have more harmonic and spurious energy than this as a matter of course.

Interference to your reception usually from a 2 meter rig, will appear in the picture as a light herring bone pattern of diagonal lines in the picture. In more severe cases, you may have sound bars running horizontally across the screen. In some instances, the offending station's audio was 4.5MHz removed from the video carrier being received, and came through the TV as a regular subcarrier sound signal. Generally, interference is seldom found, and not severe when it is.

So by now you should be on the air and have a few buddies for local QSO's. You will quickly learn who has the best systems, pictures and programs, and your attention will shift to improving your system.



ATV From Moscow!
Don Hartman Moscow, Iowa

POWER TO THE RECEIVER

To improve your range, transmitter power is not the answer. If you have an average ATV station, you have about 10-15 watts of power output. To go to full power, 1,000 watts, is only an increase of 20 DB. High power on 432 does not come cheap! But a 20 db gain preamp for the receiver does! Very few ATVers operate a full power except for an all out DX attempt. Then the 20 DB of power will help the other station receive your picture if the other station does not have a good receiver.

Your signal decreases with the square of the distance. It matters little how much you have to start with. For a one mile path, the signal has been attenuated about 100 DB. But at 10 miles the loss is only 120DB and at 50 miles the path loss is 134DB. Obviously the secret to better range is better receiver sensitivity.

If you invest in a good preamp with a low noise figure, one which has been made specifically for ATV, you might invest $40, but gain the 30 DB needed to increase the range from 1 mile to 33 miles.

To start, your antenna might have been a single colinear array with about 6 DB gain. You can increase the size of the antenna, but there is a limit to size before it either, falls down in a wind; is chopped down by the XYL; or suspected by all the neighbors as the source of TVI. An 80 element antenna is not exceptionally large, and may be built for a few dollars in materials from plans which have appeared in QST, the ARRL Handbook, the VHF Antenna Handbook, and other publications. The colinear also looks like a commercially made UHF TV receiving antenna, so some camouflage is realized. Antenna gain is important, and so is the capture area of the antenna. Yagi designs, unless stacked horizontally and vertically in quad arrays do not offer consistant performance even though they offer high gain. You should aim for an antenna gain of about 20DB minimum.

Chances are your first receiver converter was either a converted UHF TV tuner, or a commercial UHF converter modified to cover the amateur frequencies. The mixer diode in these has a notoriously high noise figure of 10-15 DB, and the sensitivity is often on the order of 100 microvolts. By adding a simple preamp, you can increase the senstivity by 20 or more db, and improve the noise figure to a more reasonable 5-7 DB. In terms of range, this improvement alone will make your 10 watt signal equivalent to the 1 KW and not run up the electric bill either!

If you were in the 3-6 mile range with converter alone, you should now be in the 10-25 mile range. This from adding a good preamp and antenna to your system.

The coax is very important at UHF frequencies. Old reliable RG 58 or RG 59 will not work! Even though RG 59 is sold as TV reception cable, at UHF the loss is not tolerable. Even RG 8, or RG 11 will have an appreciable loss. If there is a signal at your antenna which is 10 DB above the sensitivity of your receiver, enough to provide a visable picture, and you have 10 DB of coax loss, there is no signal at the receiver, and no preamp will find it either. If you use a good coax with only 1-3 DB of loss, you could still receive the signal well enough to discern a picture. Those little DB losses really add up if you don't watch out.

How sensitive is your system? Any losses before the first amplifier are equal to an increase in noise. A 6DB cable loss is an added 6DB to the noise of the system. If you were to use 300 ohm twin lead, there is a matching balun in the receiver which will add about 6DB loss.

Needless-to-say, you will want to use good coax directly to the input of your preamp or converter. It's also best to have the preamp as close to the antenna terminals as possible. Once the signal has been amplified, the cable loss to the receiver is much less important. You could even mount the converter at the antenna, so the down lead will have less loss because of the lower frequency signal.

There is a point of diminishing returns in how high you put your antenna. The coax losses, and the cost of the tower may well limit your ambition.

If you live in the country, it is important to have your antenna well above the tree tops. Earth ground at UHF frequencies is not at the top of the soil, but at the top of the trees. Foliage absorbs your UHF signal. It is not uncommon to have your range cut in half between winter and summer because of the trees, bushes and shrubs.

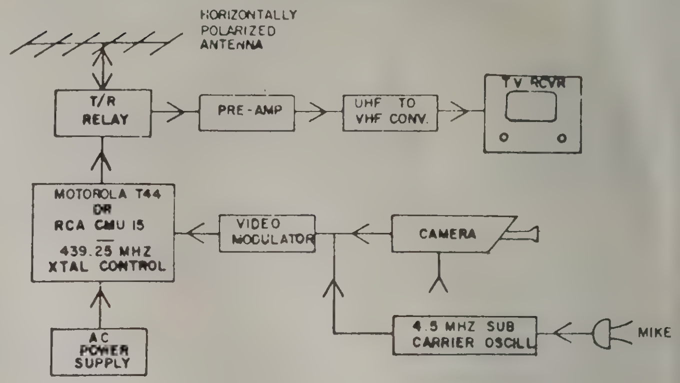
If you live in the city, you will find that buildings are wonderful (?) reflectors and absorbers of your signal. Although apartment building bounce DX is not known for its achievements, if you can get above the near buildings which block a large portion of your horizon, your signal will be able to reach out a substantial distance. Often, the near buildings can be used to reflect your signal in a desired direction, much like microwave systems use reflectors.

An easier way to check your ATV range is by using 450FM. Recently the 450MHz band has had a growth of FM activity in the upper 5 MHz of the band. If you can communi-

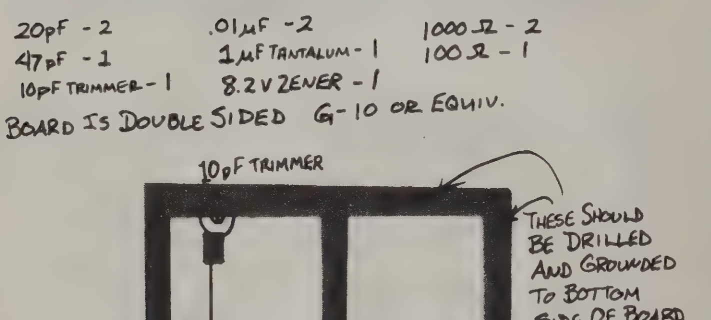
cate with a 450FM rig of similar power, you should be able to send a picture to the same station, too. The antennas and receiver sensitivty should equate the FM and TV systems. Remember, the FM receiver needs only a fraction of a microvolt for an audible signal, while the ATV receiver needs a few microvolts, so antenna gain is important. This is also a good indication of an honest estimate of your expected ATV range.

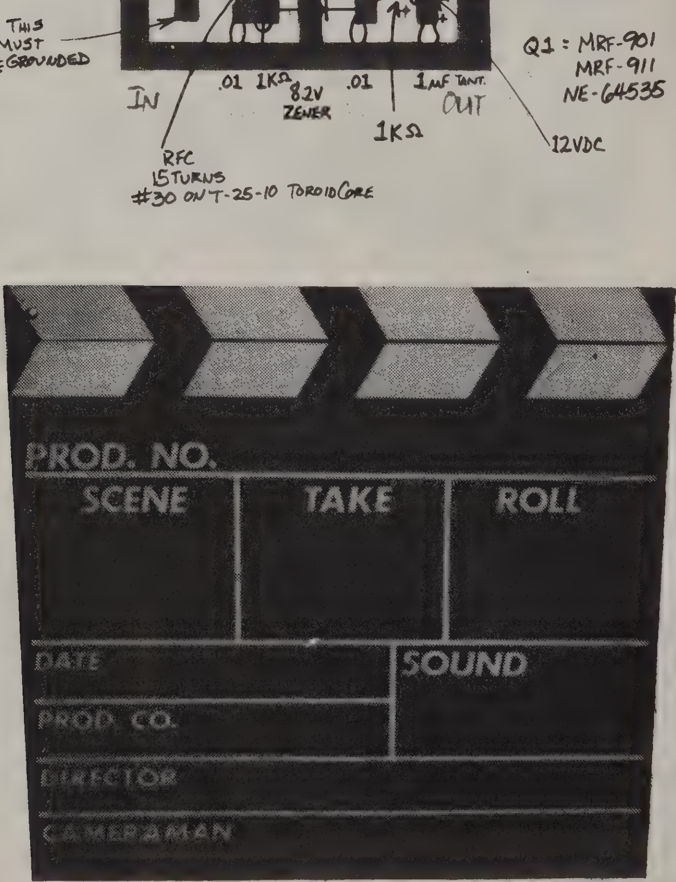
If you want optimum range, it is necessary to mount your ATV preamp at the antenna with a TR relay. A preamp at the shack end of your coax is looking for a signal which has had to crawl its way through a lot of wire, and may be lost in the noise at the preamp input. If two or three DB of signal is all that is needed to wipe out the signal, your coax will gladly oblige!

TYPICAL INEXPENSIVE 15 WATT ATV STATION



SIMPLE HOMEBREW ATV PREAMP
BY Dave Williams WB0ZJP





HOW TO SHOOT THE TUBE
SCATV NEWSLETTER

I know at one time or another we all have wanted to get on film that one special ATV picture. I hope with some basic info, you'll feel more at ease at just going ahead and doing it.

I'll start with some basic facts about the tube. As you know in video, there are 60 fields per second or 60 complete pictures a second. With that in mind logically one wouldn't want a shutter speed shorter than 1/60. Of course this was our own random interlace. Now in 2:1 interlace there are 60 fields and 30 frames per sec. Alternate scan lines make field no. 1 then in retracing, the beam scans inbetween the first field lines making the second field. That means in 1/30th of a sec. one complete frame is produced. But in shooting with your camera best results are had if you shoot at 1/30th. This insures a smooth line free picture.

The contrast should be set where it looks the best. Brightness should be adjusted so that room light is not hampering the picture contrast. Of course, a low or even yet no room light is preferred.

So far we've just hashed out some common sense basics. Now into some numbers.

If you guys own a camera with built-in averaging light meter, adjustable f/stop and adjustable shutter speeds, you've got it licked. Especially if it is a Single Lens Reflex.

With the shutter set to 1/30th the film speed now determines the lens opening or f/stop no. Following is a chart of typical settings I have found on my own Mamiya/Sekor 1000DTL SLR camera.

CHART No. 3

TYPE & NO.		LENS SPEED	SHUTTER SPEED RANGE
KODAK	X-15F	f/11 (fixed)	1/45th (flash) - 1/90 (w/o fl)
”	X-35F	f/8 (vari)	1/45th (flash) - 1/90 (w/o fl)
”	608	f/11 (fixed)	1/45 to 1/125th (auto)
”	708	f/5.6 ”	1/30 to 1/300th (auto)
”	18	f/11 ”	1/40 (flash) - 1/90th (w/o fl)
”	28	f/9.5 ”	1/30 - 1/160th (auto)
”	38	f/8 ”	t sec. to 1/225 (auto)
”	48	f/2.7 ”	1/30 - 1/250th (auto)

Looking at this chart carefully and comparing it with the facts shown on Chart no. 1 you will find that with a film speed of ASA 64, only the last two will do the photography.

CHART No. 1

SHUTTER	ASA	f/no.
1/30	25	1.4
"	40	1.8
"	64	2.8
"	80	3.2
"	100	3.2
"	200	4.8
"	400	5.6
"	800	8
" (Polaroid)	3000	approx. 22 to 32

These numbers are of course approximate, due to your own personal adjustments to the set.
HINT: If for some reason there is quite a bit of snow, you can keep the shutter open say for 4 or more frames. (If again your camera has the adjustable shutter speed). This way the noise or snow will wash away because of its random nature. The picture information will just reinforce itself on the film The snow will metl and leave a less grainy picture but the resolution will never be recovered. But it does help. Put your camera on a tripod and set the camera speed to 1/4 or 1/8th of a second.

CHART No. 2

SHUTTER	ASA	f/no.
1/4	25	4.8
"	64	8
"	80	8
"	100	11
"	400	22
1/8	25	3.5
"	64	5.6
"	80	5.6
"	100	7.2
"	400	22

Polaroids lend themselves beautifully to ATV photos just because you have instant results. One word of caution though, the ASA 3000 speed of the B&W film is very fast so the f/no. must be rather large and CRT brilliance held low. The chart no. 1 will give you some idea. Some experimenting is recommended.
Paralax is a problem for cameras that have separate viewfinder from the film lens. So if you have a SLR you're in luck. But if your camera is of the first mentioned, read on. Notice the alignment needed to make sure of the full frame picture.
Raise the camera the same distance as the distance between the viewfinder lens and the camera lens centers. The idea is to keep the center line of the main camera lens and the CRT the same. A tripod will make things easier to hold steady.

UNITED STATES
AMATEUR TELEVISION SOCIETY
DEVOTED TO HAM TV
Founded in 1963

SPECIFIC RECOMMENDATIONS

The beginning ATVer will find that the array of equipment needed for a complete operation may be bewildering. While it is not the purpose of this book to "plug" any particular product or item, there are some items which have proven to be easier to use than others and serve as a basic station system. The receive portion was chosen on the basis of items which could be easily obtained and cost less than $100 total.

The Antenna we suggest is only one of several which would serve the ATVer well. A good antenna which would offer great gain would be the J-BEAM MBM-48 or KLM 420-470-27. These are of the Yagi design with multiple driven elements for the needed bandwidth required for ATV. An alternate would be the Cush Craft DX 420. It is suggested that the reader inquire as to exact cost and shipping charges before ordering. Before mounting, you should ascertain what polarity is used in your area. The east coast metropolitan areas use vertical and the mid-west and west use horizontal. The recent introduction of circular polarization allows both to be received.

A bandpass filter such as described in the ARRL handbook (3/4 Meter Bandpass filter) is a valuable addition. The filter will eliminate interference from commercial UHF TV and two way radio transmitters in your area, reduce the front end noise and improve reception.

Gary Adams N9GA, Illinois takes a close look at a 48 element English made J-Beam at the 1982 Fall A5 Conference.

For best results, a preamp should also be used with any converter.

Coax. RG-8 can be used if you have a transmitter/receiver to antenna distance of less than 30 feet. RG 8 has a loss of about 3 DB for 50 feet at 440MHz. The better route is 1/2 inch hard line, or 7/8 inch hard line. The 1/2 inch made by Phelps Dodge (and others) has a loss of 1.9 DB per 100 feet, less than 1/3 the loss of RG 8. At 68¢ per foot, it's somewhat expensive, but the lower loss is well worth the expense. Remember each 3 DB of loss reduces the signal by 1/2, coming and going. Phelps Dodge nomenclature for the 1/2" coax is FX 12-50H, 50 ohm. Minimum bending radius is 5", so a short length of RG 8 will be needed to allow you to rotate your antenna. Connectors are $5.50 for UHF and $8.50 each for type N. Type N is a constant impedance connector and has a lot less loss than the familiar UHF (PL-259) type connector. The address of Phelps Dodge is: Route 79, Marlborough, NJ 07746. Be sure to use ZIP codes as there are two cities of Marlborough in New Jersey!

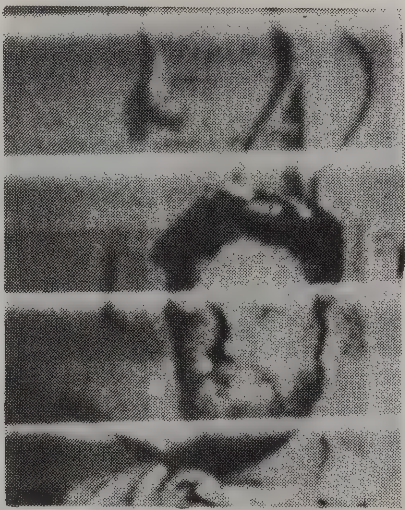
PORTABLE & MOBILE ATV
by Mike Collis WA6SVT

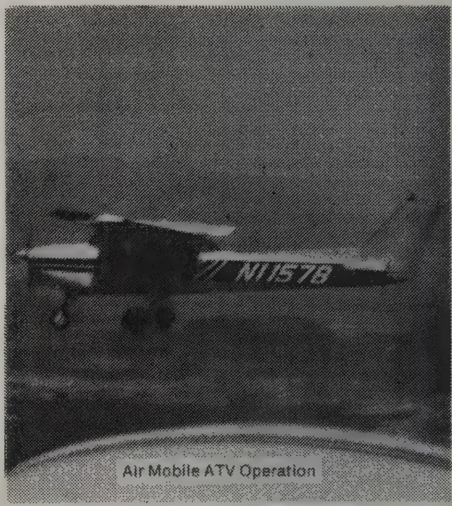
Many ATVers take atv to their car and some use atv in a airplane or boat. Aeronautical mobil atv can ge a good disaster assistance tool as disaster headquarters can have a monitor to see first hand the disaster area. Races, parades, and other events can be covered with mobil and portable ATV setups.

Installation of gear should be done in the same manner as other ham gear. Antennas can be as simple as a quarter wave ship or as complex as a large colinear vertical. On aircraft a quarterwave whip is usually temporarily mounted on the foot step upside down as underneath the plane. On boats a large gain vertical is desired for best coverage. On automobiles the antenna should be in the clear to minimize mobile flutter. A 2 meter 19 inch whip works very well as a gain colinar for 434 MHz or 439.25 MHz. ATV test done with K6KMN using several different 450 MHz antennas were tried and the 2 meter whip worked as well as the best 450 colinear mobil antenna. Most of us have a 19 inch whip already on the car. The whip has a good match into a 50 ohm system. Some ATVers go all the way as the family, John KA6HXX, Joan WD6BZN, and daughter Brenda KA6OXN, took a 190 SL Mercedes sports car and transformed it into a super atv mobil complete with a 6 DBd gain colinear 8 foot tall and a 35 watt transmitter. They have contacted stations 50 miles away. The best DX for mobil ATV was from Mark WB7AJC on board the USS Tuscalouska 380 nautical miles out to sea. Marks transmitting video was seen by WA6JCG, WB6ROP, and other San Diego ATVers. Mark was also seen by WA6SVT and WA6ZMI in Los Angeles. Mark was using a barefoot P.C. Electronics TC-1 running 7 watts into a broomstick antenna. San Diego stations had sound and color. Wow, what a DX shot!

Tom O'Hara has had aeronautical ATV several times from rented airplanes, its neat to see your QTH dive bombed while looking at your atv monitor. Several stations in some areas have setup civil air patrol aircraft with atv to show crash sites to headquarters. Video T hunts are a blast; one year Ernnie, WB6BAP set up as the hidden transmitter and was in a canyon with the camera located several yards away looking at the road, as the mobil trackers saw themselves coming up the road the signal weakened to a snowy picture and would not get stronger also no sign of the hidden transmitter site. The mobils had to go on foot over many acres to finally find the hidden transmitter.


KA6HXX & FAMILY MOBILE ATV


WB7AJC 200 MILE DX
ON USSTUSCALOUSA



AIR MOBILE ATV OPERATION

PORTABLE FSTV


WB0KFB 10 WATT PORTABLE FSTV


W6ORG MOTORCYCLE ATV AT ROSE PARADE

CHAPTER 6
RECEIVING ATV
By Tom O'Hara W6ORG

Getting a good snowfree picture over a 15 to 100 mile path is not too difficult, but the techniques required leave little margin for error. You may be able to hear the world on 20 meters with a clip lead to your bed springs, but at UHF it takes a good broadband resonant antenna, above the tree tops, fed with quality coax, connected to a downconverter with as low a noise figure as you can afford.

ANTENNAS AND POLARIZATION

If you have a limited amount to spend on your atv system, put most of it in the antenna system. There is a limit to the sensitivity you can get at the front end of the downconverter no matter how rich you are, and it would be silly to throw it away in lossy coax, poorly constructed connectors, lack of weather proffing, or antenna height or type, before the signal even gets there. Trees and other foliage really absorb UHF energy. An experiment with a walnut tree 70 feet away showed a 15 db drop in signal by just lowering the antenna 5 feet below the tree top.

Since TV is a wideband mode, the antenna must also be wideband. Most simple yagi type antennas are only 4 mHz wide at the 3 db points and are unsuitable. A good antenna will be 3 db down at the 420-450 mHz band edges so that its rolloff will not affect the amplitude and phase of the color, sound, and resolution. The feedpoint impedance should be a flat unbalanced 50 ohms to match the coax feed line. If the antenna has a balanced 50 ohm feed, a balun should be used to prevent pickup and pattern distortion from the coax line. If no balun is used on these antennas, it usually costs about 2 db of the possible gain. It will not show up on a power meter as reflected because the meter senses the return on the inside of the coax braid, and the balanced radiation is on the outside of the coax near the antenna. There are 2 commercially available antennas that meet the criteria and have measured 14 db over a dipole. The J Beam MBM48/70 with builtin balun, and the KLM 420-470-27 with the 420-470-50 balun.

While a popular arguing point, the polarity of the antenna is not so important as having the same as used in your area. A exhaustive US ARMY study concluded from data taken at many frequencies and areas that above 300 mHz the communications reliability showed no consistently best polarity. Below 300 mHz however horizontal was best. For example 2 meters averaged 2 db better horizontal. But if you cross polarize you can be down 20 db. Most areas are vertical only because of a existing or planned atv repeater, or the original group were FMers. There are no readily available omnidirectional gain antennas for horizontal polarization, but many for vertical. The areas that are horizontal come from groups that are also on 432 weak signal DX or SSB and want to use the same antenna for both modes.

CABLE LOSS

Many have proudly looked up at their new antenna system and bragged about how great the pictures come in, but become suddenly quiet after the first rain. That new run of coax can become a garden hose and useless for RF if not weatherproffed. All exposed connections must be well wrapped with vinyl tape and sprayed with clear epoxy to prevent moisture getting in. Once the braid oxidizes from moisture it will become very lossy because the individual wires will not make good contact with each other. It won't show up as a vswr but rather improves any that may have been there before. If this happens just chalk up the experience and replace it all or if long enough, keep cutting it back until no evidence of moisture or oxidation.

Use good low loss RG8 size coax with tight braid, at least 95% shield, or copper jacket hardline. Belden 8214 (3.8 db/100') or Saxton 8285 (3.5 db/100') are good low loss foam types or at a sacrifice of a extra db of loss per 100' any good mil grade of RG213 or RG214 (4.8 db/100') is fine. If you can afford copper hardline and have a run over 70' then you can save another db or two. However take care with connectors and the transitions to coax around the rotor and in the shack. Stay away from adaptors if possible and go by the connector construction instructions in the handbooks. Many have put money into hardline only to throw it away at these transitions. The aluminum hardlines, while lower cost, have higher loss for the same diameter and tend to crack and loosen at the connector from wind vibration, temperature changes, etc.

One way around the coax loss is to place the downconverter at the antenna in a weather proof enclosure with a T/R relay for transmitting. The loss in 75 ohm RG6 between the antenna mounted downconverter and the TV have very little effect on the sensitivity as compaired to the 2 or 3 db you would have had with the downconverter in the shack.

SENSITIVITY

There is a limit to the weakest signal presented at the downconverter input that you can see on the screen. Adding more and more preamps will only give adjacent signal overloads and intermods. Most specs talk about front end preamp noise figures. Whats it all mean? Noise figure is used as a reference to compare devices to select for any mode or communications system. You can't make a blank statement such as "use this device for .1 microvolt sensitivity" and have any meaning, without also stating the bandwidth and signal to noise ration. Noise figure takes out these two variables so that anyone can figure out the microvolt sensitivity for his favorite mode or anyone elses.

The theoretical best you can do is receive a signal at -174 dbm (1 microvolt is -107 dbm). But this is at 1Hz bandwidth and the preamp device has zero db noise figure. Of course this is not a real life situation, but it gives us a starting point to scale up from. You can add the noise figure of the preamp and the bandwidth of your receiving system. Most standard TV IFs are 3 mHz at the 3 db points which adds about 65 db or up to -109 dbm. Add to that the system noise figure and you end up around a microvolt. FM voice communications is much more sensitive because the receivers are only about 15 kHz wide or add 42 db for -132 dbm which is about .05 microvolts possible.

Best snow free (42 db snr) DX for the typical atver is 40 miles. This says that you can see sync bars out to maybe 300 miles. If any of the variables of the typical atv situation is improved 6 db, the distance will double. But isn't it all the variables that make the ham DX QSO interesting and fun? To give you a reference, our example assumes:

1. 10 watts pep smit power.
2. 3 db loss in coax at each end.
3. 14 dbd gain antennas at each end.
4. 3db receive system noise figure.
5. 3 mHz system bandwidth.
6. Line of sight path.

To get more DX you can jump up to 90 watts for 9 db, antenna mount the downconverter for 3 db, or put up dual antennas for 2 to 3 db more. Temperature inversion ducting, usually from June thru October, can give unusual DX. They can happen anytime, but are found mostly in the late afternoon and evening as warm air from the ground rises a few thousand feet, and cooler air comes in below. It only takes 2 to 5 degrees of warmer air 100 ft. thick above to do it. In LA it causes the smog but allows good pictures 100 miles away from San Diego. Monitoring on a common 2 meter FM simplex frequency with a omni antenna helps indicate the openings and after establishing contact with the DX station more easily allows rotating the atv antennas at each end to talk the picture in.

THE EYES HAVE IT

Just as our ears and brain can pick out signals some db below the noise, our eyes and brain can see call letters in the snow. Large black letters on a white background seem to show up best. So the effective bandwidth is reduced resulting in better sensitivity than the receiver bandwidth. Experimentally this seems to be the equivalent of a few hundred kHz to see sync bars in the snow.

Most atvers rock the antenna back and forth looking for these weak sync bars in the snow and then fine adjust for the best signal on their preamps and downconverters. This is better than just peaking with a voltmeter on the video IF agc as max gain doesn't always coinside best signal to noise ratio or sensitivity. A S-meter or voltmeter on the video IF agc line is greater however for lining up the antenna on stronger stations. Changes in snow level don't always tell weather or not one preamp or downconverter is more sensitive than the other. The rule of thumb is to add gain until just before the video IF agc begins to come up with no signal present. Any more gain just pumps up the agc and won't give any more sensitivity. In fact it will decrease the dynamic range of the system which increases the possibility of overloads and intermod interferance. The ARRL Handbook chapter on VHF and UHF receiving techniques has much more on the subject.

There is a natural limitation on us and that is the cosmic noise level or sky noise. For the 420-450 mHz band this will vary between the equivalent of .6 to .9 db noise figure. So putting extra money into fancy devices with noise figures lower than this will give little return. For instance, going from a 2 db device to a .5 db device, you would get more by putting the 2 db device up at the antenna if your coax loss is 2 or 3 db. But this is another one of those qualitative judgments that make for lively discussions on the air. One may proclaim great things for 1 db improvement but another doesn't think that unless that change nets at least 3 to 6 db its not worth it.

TVs used keyed AGC. That is the agc is sensed only during horizontal sync time. This decreases the chance that the AGC will vary with picture changes or interferance. So a signal generator with a 1 kHz tone may not give the same results as a video modulated signal generator. One way to compare preamp devices is to purposely misadjust the horizontal hold so that a few horizontal bars appear on the screen with a weak video modulated signal from a generator. Then slowly increase the signal until it locks in. The horizontal locking circuit depends on the signal to noise ratio, so therefore the best device is the one that locks up with the weakest signal. This assumes sufficient system gain where the Video IF AGC (not the RF delayed AGC) has started to change before lock, so that low gain is not mistaken for poor noise figure.

To minimize adjacent channel interferance, set the VHF tuner to the weakest channel (2, 3, or 4) in your area with the TV antenna connected, AFC off, and the fine tuning carefully adjusted. Run 75 ohm coax between the downconverter and the TV sets antenna input. If it only has a twin lead input add a 75 ohm to 300 ohm balun.

TV RECEIVERS

Most TVs manufactured in the last few years seem to be poorly aligned. The gain and IF bandwidth from model to model, and manufacturer to manufacturer vary quite a bit in our experience. Most hams do not care to get into their TV and align and peak the IF or tuners, or have the sweep or signal gens to do it. If your TV has low gain the thing to do is not to add a preamp, but to add a amp between the downconverter and the TV. Most intermods from strong off channel signals do not occur in the preamp stage but rather the first mixer. This is because most of the selectivity is done at lower frequencies in the tuner and IF. Most preamps are very wide band and amplify the desired signal as well as the garbage. With a channel 3 amp there is some selectivity in this amp and the tuner to help reject the garbage before it gets to the tuner mixer. There should only be enough gain ahead of the first mixer to determine best noise figure, then selectivity filtering, and only then the bulk of the required gain to the detector.

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SAFETY PROCEDURES

Be careful, do not let the coax F connector touch any metal in the TV as most are hot chassis to the AC line. Before connecting any cable or wire grounds to the chassis of the TV, check your TV schematic to see if it is a hot chassis or is power transformer operated. Also you can check with a ohm meter from each side of the AC line to chassis. Many low price TV sets run both AC and DC with the use of an isolation transformer which is ideal for sale ATV Dremation and Monitoring.

W6ORG © MARCH 1982

"WHY GOOD COAXIAL CABLE AT UHF FREQUENCIES IS SO IMPORTANT!"

CABLE LOSS

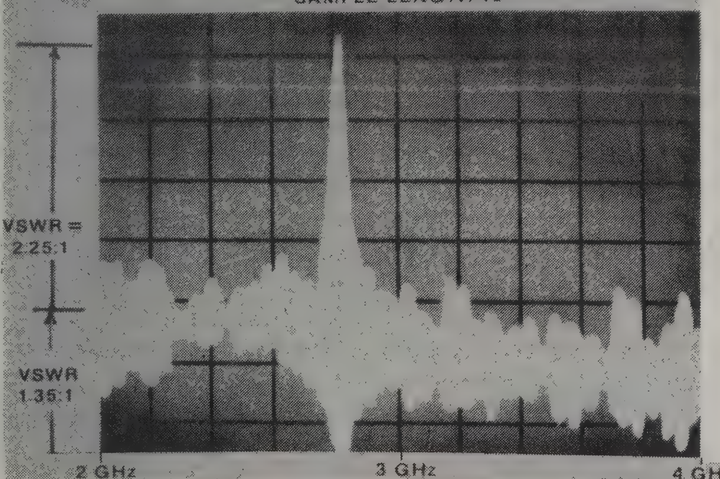

Fig. 1
INPUT IMPEDANCE (VSWR) VS. FREQUENCY
50 OHM 3/4" COAXIAL CABLE
SAMPLE LENGTH 15'

THE UHF-ATV SYSTEMS "WEAKEST LINK"

Hello, Captain Video here, bringing you newcomers some vital information to help you get that FSTV system up and going! It's a shame that we all spend so much time choosing a commercially built ATV transceiver or homebrewing up a transmitter and receiver, installing a good low-noise preamp and rejection filtering and finally add a moderate to "big-gun" antenna system and then turn around and devote about 5 minutes to our "feedlines." Most of the newcomers to ATV will immediately use an old run of coaxial cable that worked just fine for the HF bands for their new FSTV system. With all of us well known for "bargain huntermanship," we just naturally seek out those "good buys" at cheap prices. On the other extreme, those who are indeed aware of the need for low-loss transmission line for UHF frequencies sometimes still make the mistake of going out and paying "higher than required" prices for double shielded cable such as RG213 at 55¢ per foot. Somewhere along the line, the ATV operator learns that less expensive cables such as Belden 8214 or Saxson 8285 runs only 34-40¢¢ per foot with even better loss figures. A basic 10-watt FSTV station with 75-100 feet of good Belden 8214 will still show a loss of ½ power at the antenna at best (This assumes that you are also using proper type "N" or BNC connectors suitable for real UHF work). My own tests conducted with a 75 foot run of 8214 versus a 75 foot run of Andrews 7/8" hardline showed with 40 watts applied at the transmitter, 23 watts could be measured on a BIRD wattmeter (200-500 Mhz. slug at 50W) on the other end of the 8214 with 38.5 measured on the bigger "hardline" cable. That convinced me right there that the extra dollars were worth the investment (loss on receive works as well). Figure 1 shows VSWR characteristics against microwave frequencies, Figure 2 illustrates how coax is assembled and Figure 3 shows specifications of the popular Bleden 8214 coaxial cable.

Many have proudly looked up at their new antenna system and bragged about how great the pictures come in, but become suddenly quiet after the first rain. That new run of coax can become a garden hose and useless for RF if not weatherproffed. All exposed connections must be well wrapped with vinyl tape and sprayed with clear epoxy to prevent moisture getting in. Once the braid oxidizes from moisture it will become very lossy because the individual wires will not make good contact with each other. It won't show up as a vswr but rather improves any that may have been there before. If this happens just chalk up the experience and replace it all or if long enough, keep cutting it back until no evidence of moisture or oxidation.

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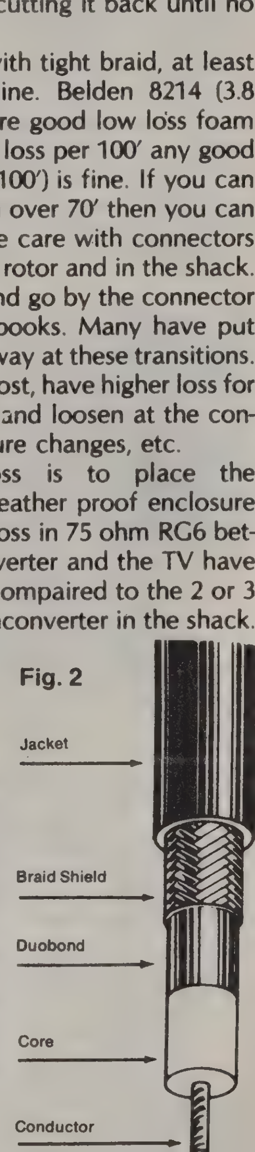
Some good further reading material on transmission cables; BELDEN ELECTRONIC WIRE AND CABLE CATALOG, PO Box 1331, Richmond, Indiana 47374 ($2.50), TIMES WIRE AND CABLE CO., Catalog No. TL-7, 1972 c/o JASCO INTERNATIONAL INC. PO Box 29184, Lincoln, Nebraska 68529, THE RADIO AMATEUR'S VHF MANUAL, c/o ARRL, 225 Main, Newington, Connecticut 06111, 75-50 Ohm Hardline Matching System article by Lewis T. Fitch W4VRV in October HAM RADIO, 1983 edition of THE RADIO AMATEURS HANDBOOK, ARRL.

Fig. 2



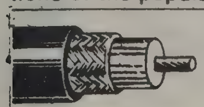
 8/U TYPE	8214†	50 100 400 500 1000	15.2 30.5 121.9 152.4 304.8	98388 98387 98386 98385 98384	11 (7x19) [2.74] bare copper 1.15Ω/M' 3.8Ω/km	Cellular Poly- ethylene	.405 .285	10.29 7.24	1 bare copper 1.1Ω/M' 3.6Ω/km 97% shield coverage	50 Black vinyl jacket.	78%	26.0	85.3	50 100 200 300 400	1.2 1.8 2.6 3.3 3.8	3.9 5.9 8.5 10.8 12.5

Fig. 3

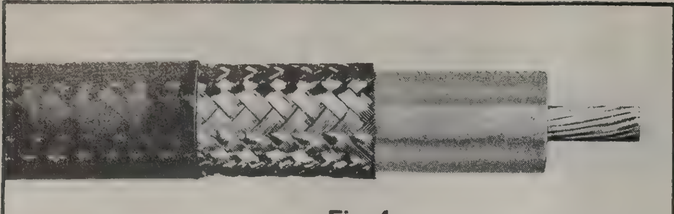


Fig. 4

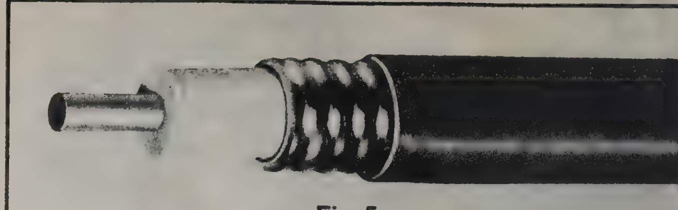


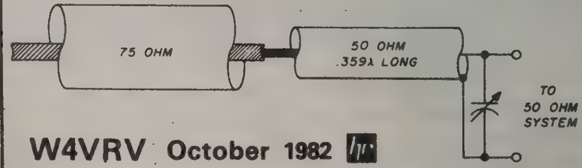
Fig. 5

Figures 4 & 5 show the breakdown of the more popular and less expensive flexible RG8U type coxial cable and the lower loss rigid hardline model. A very common misconception in ATV work is SWR readings. Even with a good BIRD wattmeter and the proper slugs for UHF work, true SWR readings can sometimes not be seen "in the shack." For example, the basic 10-watt ATV station using even 8214 coax at 100 feet has at best 5 watts at the antenna. By the time a watt or two not disipated out the antenna starts the return route back down the cable, half of it again absorbed and loss hardly detectable as SWR on the users wattmeter. So, claims of no SWR are mady by the UHF experimentor. Only until a higher power linear amplifier is used can the real nature of the entire antenna system be judged. It confuses the operator when he adds in the new linear and then starts to "see" SWR present and will sometimes just blame it on the new addition or that extra cable used. It is not uncommon to see 1.5 to 2.0 SWR on multi-element UHF antenna systems especially where stacked arrays are used. Readjustments (if possible) of antennas or playing with the impedances by lengthening or shortening the transmission lines by either direct or matching devices can reduce SWR reflection.

Rule: Never scrape or shave down center conductors of any cable for UHF operation. Your removing wattage going to the antenna and sensitivity to the receiver (W5DFU).

Figure 6 shows a simple method of putting a plug on 75 ohm hardline. Some great buys exist at "hamfests" or local cable-TV companies on low-loss 75 ohm transmission lines that are end runs (sometimes as much as 390-500 feet) not used and many times discarded. Use of this cable on 50 ohm systems if not matched in some way with present a high mis-match. Some ATV'ers brag about using the better cable but do not want to check their SWR or will be reluctant to talk about measured reflection which is often as high as 3-1. Don't be fooled by easy schemes to use non 50 ohm cable. There are a number of good matching device articles around as shown in Figure 7. John Rohner's TVRO Satellite Digest, January/February issue 1982 has a great article on connecting hardware to 75 ohm CATV cable. Lionel Fortier Jr., author of the article advises that type N (UG 21G/U) silver-plated brass connectors can easily be used if properly modified. Stainless Steel "N" connectors do not solder well and should be avoided. Take ¾ inch domestic copper cold water pipe and cut into 1½ inch lengths. Cut a strip lengthwise with the width according to the size of cable's shield diameter. Once form fitted, a torch solder method can be accomplished. The use of small hose clamps can be used for a proper connection to the "N" connector casing with the "tip" soldered or crimped to the center conductor. Double end females can be used for more flexible jumpers of 8U type coax to get to the ATV rig. Remember, every extra jumper means more plugs and more loss!

Fig. 6



W4VRV October 1982

One-band 50- to 75-ohm match.

Fig. 7

Fig. 8

TABLE 8-III CHARACTERISTICS OF COMMONLY USED TRANSMISSION LINES

The Radio Amateur's VHF Manual ARRL

Type of Line	Conductor Size	Z_0 Ohms	Velocity Factor	Coax OD Inches	Attenuation in dB/100 ft MHz: 50	144	220	420	Power Rating, Watts MHz: 50	144	220	420
Open wire[1]	12	400-600	0.975		0.13	0.25	0.5	1	Over 1 kW			
Open-Wire TV Line, 1/2-inch[2]	18	400	0.95		0.3	0.75	1	1.8	Over 1 kW			
Open-Wire TV Line, 1-inch[2]	18	450	0.95		0.3	0.75	Not recommended		Over 1 kW			
Parallel-Conductor Solid-Dielectric Twin-Lead[3]												
Standard Flat (214-056)	7/28	300	0.82		0.85	1.55	1.9	2.8	Over 1 kW when dry			
Tubular (214-271)	7/28	300	0.82		0.85	1.55	1.9	2.8	Over 1 kW when dry			
Tubular, Transmitting Type (214-076)	7/26	300	0.82		0.68	1.25	1.6	2.3				
Extra-Heavy Flat (Federal K-200)[2]	7/22	200	0.82		0.5	1	1.3	2	Over 1 kW			
Coax, Solid-Dielectric												
RG-58/U[4]	20	53.5	65.9	0.195	3	6	7	15	350	175	125	90
RG-59/U	22	73	65.9	0.242	2.3	4.2	5	8	500	250	180	125
RG-8/U	7/21	52	65.9	0.405	1.5	2.5	3.5	5	1500	800	650	400
RG-11/U	7/26	75	65.9	0.405	1.55	2.8	3.7	5	1500	800	650	400
RG-17/U	0.188	52	65.9	0.87	0.5	1	1.3	2.3	4500	2300	1900	1200
Foamed RG-8A/U	7/21	50	75	0.405	1.22	2	2.75	3.9	1500	800	650	400
Aluminum-Jacket Foamflex												
3/8-inch[5]	0.117	50	75	0.435	0.85	1.5	2	3	2200	1200	900	600
1/2-inch[5]	0.162	50	75	0.60	0.65	1.2	1.5	2.3	3000	1600	1100	800
3/8-inch[5]	0.077	70	75	0.435	0.82	1.5	1.9	2.9	similar to 50-ohm types			
1/2-inch[5]	0.108	70	75	0.60	0.62	1.2	1.5	2.3				

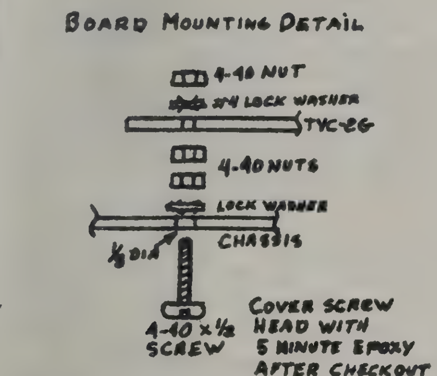
[1] Spreaders at least 3 feet apart. Maximum spacing between conductors 1-1/2 inches for 50 MHz, 1 inch for 144, 3/4 inch for 220, 1/2 inch for 420. Loss figures neglect radiation.
[2] Estimated loss, neglecting radiation.
[3] Numbers with 214 prefix are American Phenolic Corp.
[4] With all coax listed except RG-58; letter A, B, or C after number signifies noncontaminating jacket. With 58, only RG-58/U has this type jacket.
[5] Not including vinyl jacket.

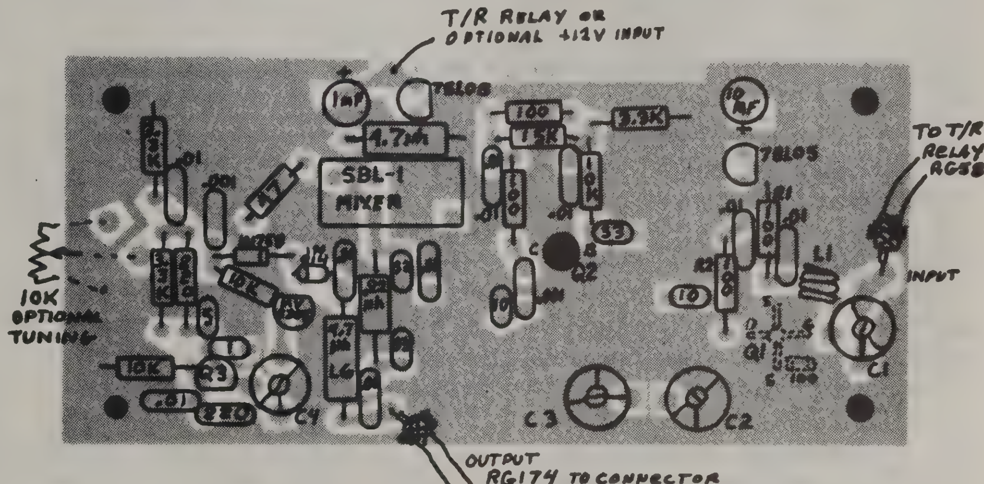
TVC-2G GaAsFET 420-450mhz ATV CONV.

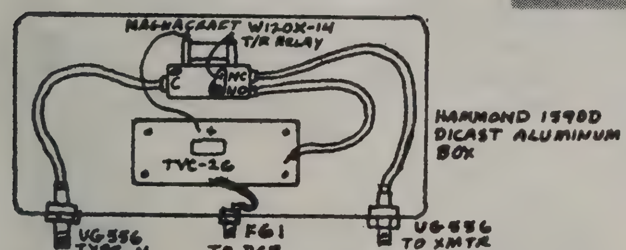
This ATV GaAsfet downconverter is designed to be mounted at the antenna for maximum sensitivity. This sensitivity improvement is even more than the coax db loss. The GaAsfet is less susceptable to frontend overload by over 30 db than most bypolar devices as well as having a extremely low noise figure. However most intermods occur in later stages, primarily the mixer, as the undesired signals also get amplified. So we put a stripline double tuned bandpass filter immediately after the GaAsfet preamp, and a lowpass filter between the MRF901 rfamp and mixer primarily to kill strong UHF broadcast TV stations and your own two meter fm talkback transmitter. The hot carrier double ballanced mixer can take almost a milliwatt input before giving significant intermods. The output is on TV channel 3 or 4.

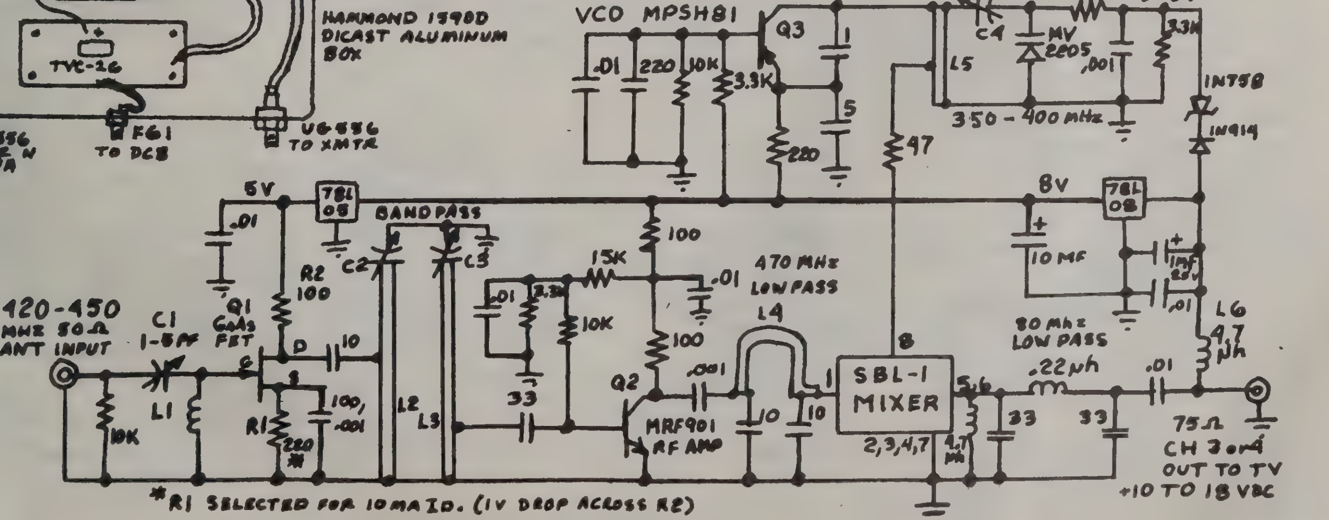
The whole 420-450 mHz ham band plus some overlap, is varicap tuned by varing the supply voltage fed up the IF coax between 10 and 18 vdc. Therefore a shielded control box, see our model DCB sheet, must be used. The DCB voltage control circuit can be made from Radio Shack parts with or without amp and put in a shielded box if you wish to build your own. The TVC-2G can be mounted in a shielded enclosure such as a Hammond 1590D or Bud CU-247 with a T/R relay and weatherproofed.

The downconverter does not have to be mounted at the antenna and powered thru the output coax at your option. In this case, clip one lead or remove L6. Connect the three leads of a 10K panel pot for tuning. Connect the external +12 vdc supply.









ANTENNA MOUNTED ATV CONVERTER W6ORG

Antenna mounting the converter will give you a increase in sensitivity equal to the loss of the coax run to the converter in the shack now. If you have a 100 ft run of Belden 8214 now it will give you 3.8 db more. Since the noise figure is determined by the first rf stage and followed with sufficient gain, the coax loss at channel 3 is relatively insignificant. In fact since the frequency is much lower, and therefore less loss in the coax you can run 100 feet of Radio Shack Foam RG6 for only 2 db loss in gain but hardly anything in signal to noise ratio. (Radio Shack 100' with F connectors..RS 15-1527 is $13.99).

The converter and coaxial t/r relay are mounted in a rain proof die cast aluminum 4x7x2 inch box. These are made by Bud (CU-247) and Hammond (1590D). A F connector (RS 278-212) for the converter output and DC control input, and bulkhead type N to RG58 UG 556B/U connectors for antenna and transmit. The N connectors have weatherproofing seals but the F connector and screw holes could leak. So I used a little 5 minute Epoxy over the six screw heads and around the nuts used to mount the converter and Magnacraft W120X-14 coax relay, also the F connector. The box is held in place on the antenna mast with large cable ties and tape. The connectors should be pointing down. Tape the cover seam and screw heads well and the conectors. Then give everything a few coats of clear <u>epoxy</u> spray....no Krylon or acrylics.

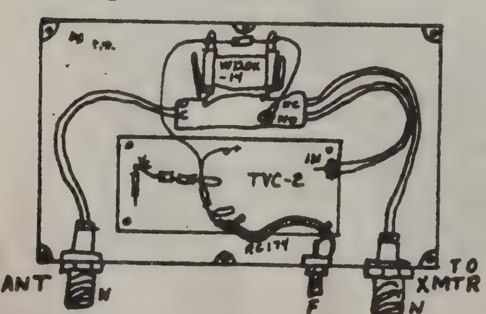
Electrically the receiver is operating when 11 to 18 vdc is passed up the converter output line. This voltage will energize the t/r relay and tune the converter across the band. In xmit the relay is not energized which is a good failsafe against xmitting into the converter and blowing it as well as saving a control cable. The 1N758A 10 volt zener drops the input voltage down to the normal varicap tuning range of 0 to 8 volts. The 1N914 diode in series with the zener helps temperature compensate the varicap. A 4.7 uH RFC isolates the IF from the DC and the .001s block the DC.

A control box must be built to operate the converter system. Most of the parts can be bought thru Radio Shack. The LM317 is a adjustable voltage regulator that must first be set for a minimum output voltage of 11 volts with a PC type trim pot. Do this by setting the panel pot used for converter tuning at zero ohms. You can get fancy by adding a smaller pot for fine tuning or a 50K trimmer across the panel pot to limit the range. Or maybe a meter with freq calibration...a 10V full scale across the panel pot.

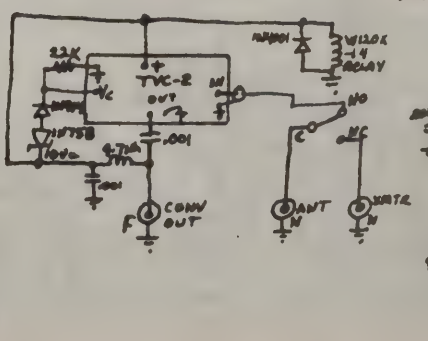
The SPDT 12v relay in the control box will ground the converter power in transmit. Connect one side of the winding to the xmtr + 13.8 VDC that is on only in xmit.

Remove the 10K freq. tune pot. Connect Vc to wiper pad.

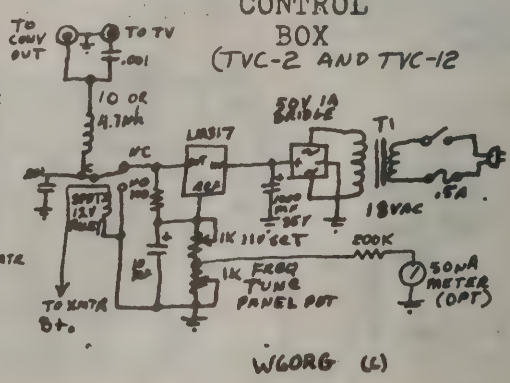
LAYOUT



ANT. MOUNT



CONTROL BOX (TVC-2 AND TVC-12)



DCB DOWNCONVERTER CONTROL BOX

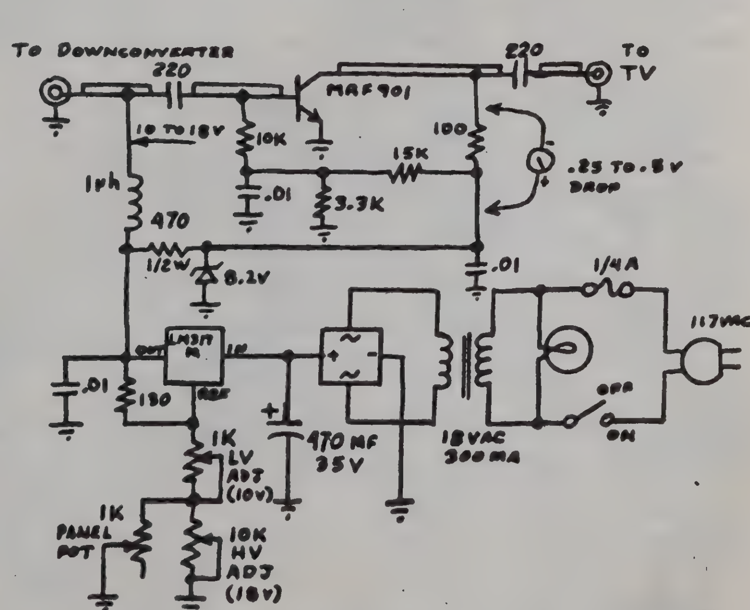
This downconverter control box provides a regulated DC voltage between 10 and 18 volts at up to 150 ma to power antenna mounted downconverters thru the coax. It also contains a MRF901 broadband 40-220 mHz 15 db gain amplifier to make up for low gain TV sets or splitter losses when driving both a TV and a VCR. While the DCB was designed for the TVC-12G and TVC-2G downconverters, the voltage variation can be adjusted for any 8 volt range from 2 to 18 volts for other converters.

The DCB comes set for 10 to 18 volts. To reset the range, turn the front panel tuning pot to 0. Monitor the voltage on the downconverter input connector and adjust the low voltage pot marked LV ADJ on the circuit board. Next, turn the front panel pot to 10 and set the HV ADJ pot on the circuit board to the desired highest tuning voltage. If you want the widest tuning possible and there are few atv frequencies in use in your area, the LV ADJ can be set to tune in the lowest used ATV frequency with the front panel pot set to between 1 and 2, and the HV ADJ then set for the highest used ATV frequency with the front panel pot set to receive it between 8 and 9.

The TV output from the DCB should be done with RG6 coax as far up to the VHF tuner in the TV as possible to prevent strong commercial TV interferance from the adjacent channel. Radio Shack has RG6 cables in various lengths with F connectors up to 100 ft (RS 15-1527). RG59 is not as well shielded as RG6 which has a aluminum foil shield rather than braid. Most new TVs have a 75 ohm F connector antenna input. If yours has only twin lead, then it can be modified by connecting a balun (RS 15-1140) directly at the VHF tuner with the twin lead cut as short as possible. Twin lead often acts as a antenna that picks up strong adjacent channel interferance. Tape the F connector to insulate it from the shell possibly touching the TV chassis. Many TVs have a hot chassis to one side of the AC line that must remain isolated from ground.

Before connecting the downconverter coax to the DCB, check the center lead to shell of the coax to make sure there are no direct shorts. Also adjust the fine tuning on the TV, with the AFC off, to the proper open channel you will be using for the downconverter output, for least adjacent channel interferance.

If the same antenna is used for transmitting, a single T/R relay such as the Magnacraft W120X-14 can be mounted in the weatherproof enclosure with the downconverter, and should be energized in receive mode. This will minimize the chance of transmitting accidently into a open relay. Do not use a single down coax with a second T/R relay as they do not switch fast enough to prevent transmitting for a few milliseconds into the output of the downconverter and damaging it.



P. C. Electronics
2522 Paxson Lane
Arcadia CA 91006

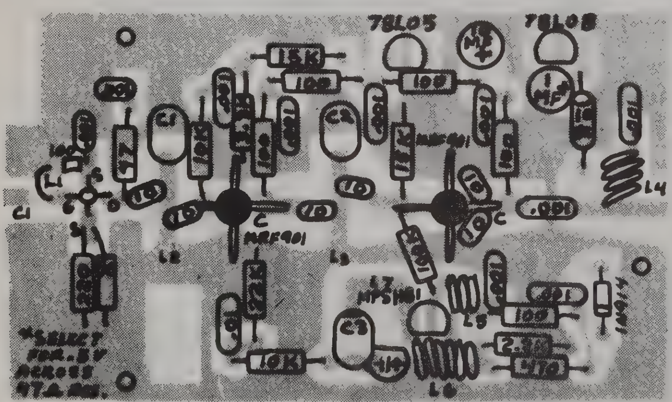
TVC-12G 1215-1300 MHZ DOWNCONVERTER

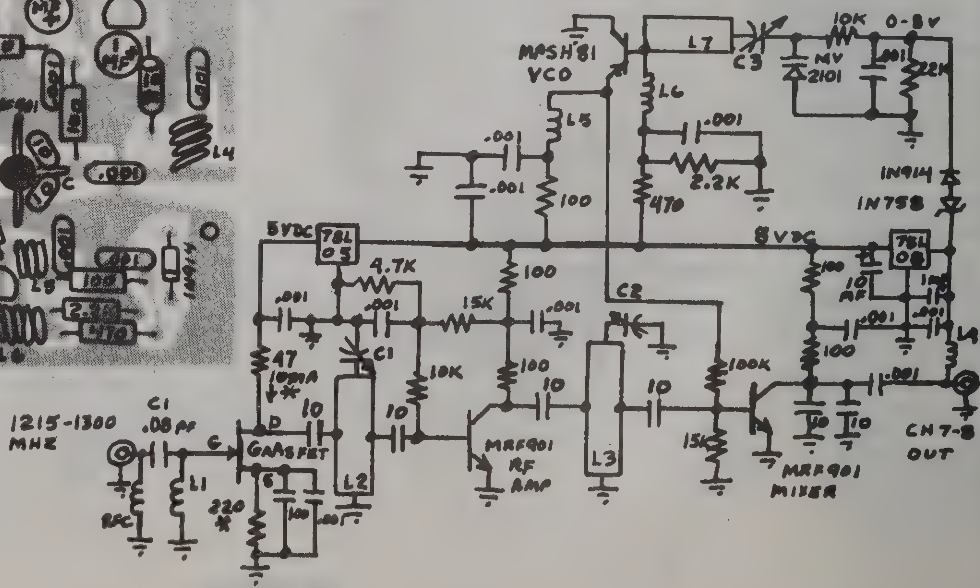
This ATV GaAsfet downconverter is designed to be mounted at the antenna for maximum sensitivity. There is no sense having a less than 1 db noise figure frontend with many DB in feedline loss infront of it. The output is on TV channel 7 or 8. While RG6 75 ohm coax has about 3 db/100 ft (Radio Shack 15-1527) at channel 8, its loss has negligable effect on sensitivity.

The whole 1215-1300 mHz ham band is varicap tuned by varing the supply voltage fed up the IF coax between 10 and 18 vdc. Therefore a control box, such as our DCB, must be used to supply this stable regulated voltage, and to block this DC voltage from the TV antenna input. The DCB voltage control circuit can be made from Radio Shack parts less the amplifier and put in a shielded box if you wish to build your own.

The downconverter must be well protected against moisture getting inside. Before mounting on the antenna, spray one coat of clear epoxy, then carefully run vinyl tape around the cover seam and then around and over the 4 cover screw heads. Do not put any substances in the cover seams or it could destroy the shielding. Next screw on to the "N" connector provided with the F9FT or loop yagi and wrap 2 layers of vinyl tape over the connection in opposite directions. Do likewise with the "F" connector IF output. The downconverter can then be held to the antenna mounting bracket or mast with cable ties or vinyl tape. The entire assembly can then be given a few coats of clear epoxy. Do not use colors as they may be conductive, or acrylics as they crack and peal in a short time when exposed.

Mount the antenna assembly as high as practical as foliage absorbsion is very great in this band, as well as 9 db additional pathloss compared to the 70 cm band. For duplex or crossband repeater operation where you want to see your own video coming back, you will need at least 5' vertical separation between vertical polarized antennas if you are running 10 watts output on 70 cm. More is necessary if higher power or horizontal polarization is used. You might be able to see your own 3rd harmonic from your 70 cm transmitter by tuning to the high end just above 1300 mHz. For this reason, the least overloaded freq. for duplex and repeaters is at the low end: 1241 simplex/duplex, 1253 primary repeater output, 1265 sec. rptr, 1277 rptr, 1289 link. Normal converter setup is to tune 1265 mHz to ch 8 with 13 vdc applied. Lower voltage tunes to a lower frequency and vice-versa.





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Arcadia CA 91006

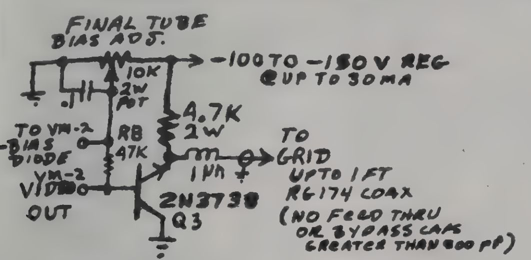
FAST SCAN ATV
VM–2 VIDEO MODULATOR

The VM-2 Video Modulator is designed to grid modulate most any Tetrode power tube with video up to 5 mHz in bandwidth. It will modulate tubes used in FM 15 watt transmitters (RCA CMU-15, etc) such as 5894, 6907, and 6939 as well as the high power rigs using 4X150, 4X250, and 8930 tubes to full AM modulation. The circuit employs DC restoration so that maximum power occurs at the sync tips regardless of picture contrast. For references on transmitters see chapter 2 of the ARRL Specialized Communications Techniques book. Also see April 1972 QST and the ARRL VHF Handbook for the K2RIW Kilowatt amp. The amp and parts for it are available from W2GN.

To maintain good color and sound, the amp must be capable of not rolling off the video thru the plate tuned circuit Q. Half wave lines work fine but ¼ wave dont (tuning cap should be at end of line rather than at tube plate). With grid modulation the grid Q wont affect the bandwidth as it would if run as a linear.

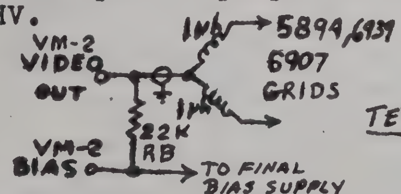
Mount the board and external components as close to the final as possible but outside any shielded compartment. Go into the compartment thru a short piece of coax, to prevent RF feedback. Remove any feedthrus or bypasses on the grid to maintain video bandwidth.

The 1uh inductor and 1200 pf cap should be fine adjusted by adding or subtracting parallel caps to 4.5 mhz using a grid dip meter or other method. This is necessary to prevent the camera coax from loading down the 4.5 mHz subcarrier. Adjust the 4.5 mHz to ½ to ¼ the peak to peak voltage of the video input at the VM-2 board video input using a oscilloscope. Check with only the camera or 4.5 MHZ on at a time.
R1 is selected to give 50 to 60 VDC at the emitter of Q2.
Select the dropping resistor for the VM-2 B+ by the formula shown.
For example if the power supply is +300 volts the Resistor is 5K, 10W.
Examples below are for both high power and nominal 15 watt rigs:



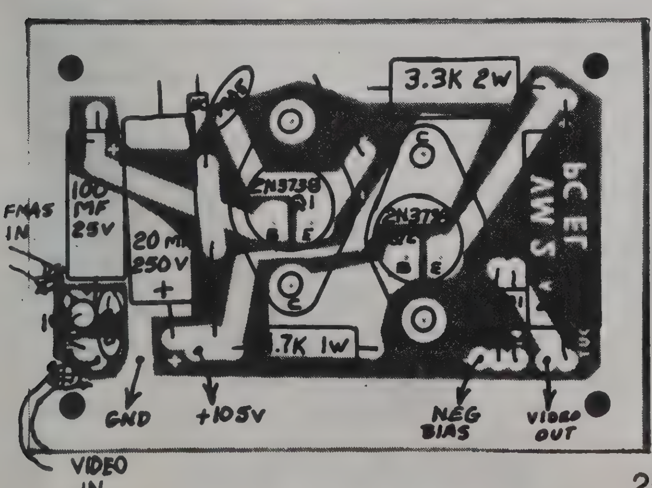
4X250, 4X150, 8930 HIGH POWER MODULATOR ADDITIONAL CIRCUITRY.
-65 V typ. grid bias

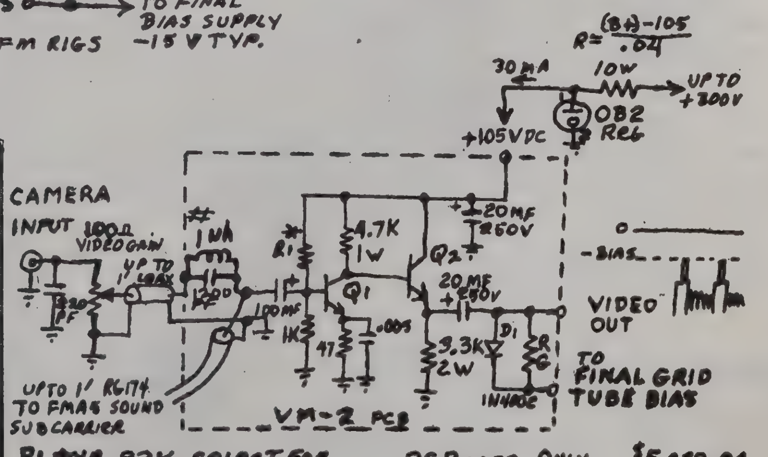
Add 10 MF 450 V video bypass caps to screen grids. Set bias pot to proper tube voltage before turning on HV. All resistors are carbon comp.



15 W FM RIGS -15 V TYP.

TETRODE TUBES ONLY





R1 TYP. 82K. SELECT FOR 50 TO 60V AT Q2 EMITTER

PC BOARD ONLY....\$5 PPD. CA
MOTOROLA 2N3738 \$5 PPD CA
VM2 WIRED & TESTED \$20 PPD

P.C. Electronics
2522 S. Paxson Ln., Arcadia CA. 91006

WGORG
Rev 1/82

TXA5 ATV EXCITER MODULATOR

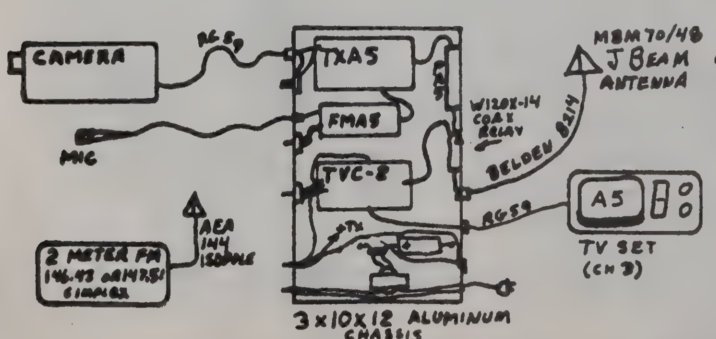
The TXA5-4B ATV Exciter-Modulator is designed to fully drive the PA5 Linear Amplifier to 10 watts PEP. The modulator section has 8 mHz bandwidth for excellent color and computer graphics reproduction. The FMA5 can be directly connected to the 4.5 mHz sound subcarrier mixer input. The video is clamped to ensure maximum power on the sync tips regardless of the average picture contrast. At the nominal 80 mw output the 13.8 v reg current is 75 ma.

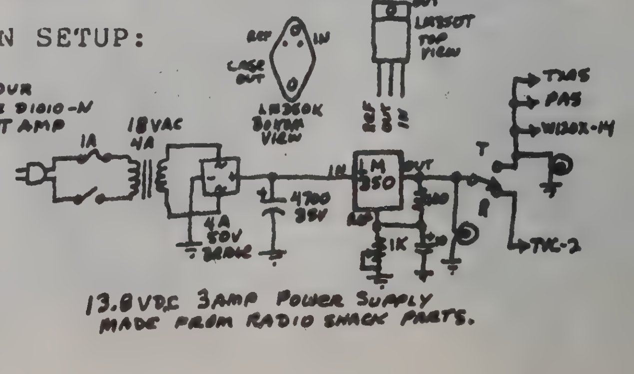
The RF section consists of a 5th overtone crystal oscillator, two doublers, and a final. The 100 mHz crystals were selected so as not to put any harmonics in the two meter band used for talk-back and atv coordination. As a option, another crystal and a relay are added for 2 freq. operation. The on board relay is necessary to keep crystal lead length to a minimum for proper operation. The relay is energized by grounding one side of the coil. Standard crystals are available from us for $15. We stock 421.25 (repeater output), 426.25 (most used 2nd freq), 434.0 (used in areas of high UHF FM repeater activity and outside of the USA), 439.25 (most popular in midwest and eastern USA), 1241 and 1253 mHz. Other freq may take up to 4 weeks from us or call KW Mfg direct at 405-5672285. The crystals are freq divided by 4, type KW-18, .005%.

Stray capacity to the chassis or shipping vibration may make fine peaking of the trimmer caps necessary. Peak with a insulated tuning tool. Monitor next transistor emitter with a VOM on the 2.5v scale while peaking. For example, monitor Q3 emitter at 100 ohm resistor lead while peaking C2 and C3. The 2 freq version is adjusted by peaking for the highest equal voltage. Typical minimum peaked voltages are shown on the schematic next to the emitters. The diode and .01 mf may be used as a final peaking detector to the VOM or a Bird Watt meter on the output of the PA5. A good 13.8 v regulated supply must be used as any ripple on the line will show up as inteferance in the picture. After peaking adjust the 1K bias pot for no more than 10 watts output or 10% less than maximum which ever is least for proper sync clamping. Connect the camera or other video source and slowly increase the video gain until the white portion of the picture limits and then back off a little. The 100 ohm pot may be removed and up to 1 ft of coax run up to a 500 ohm carbon panel pot with a 100 ohm fixed resistor across each end for convenience on the chassis panel.

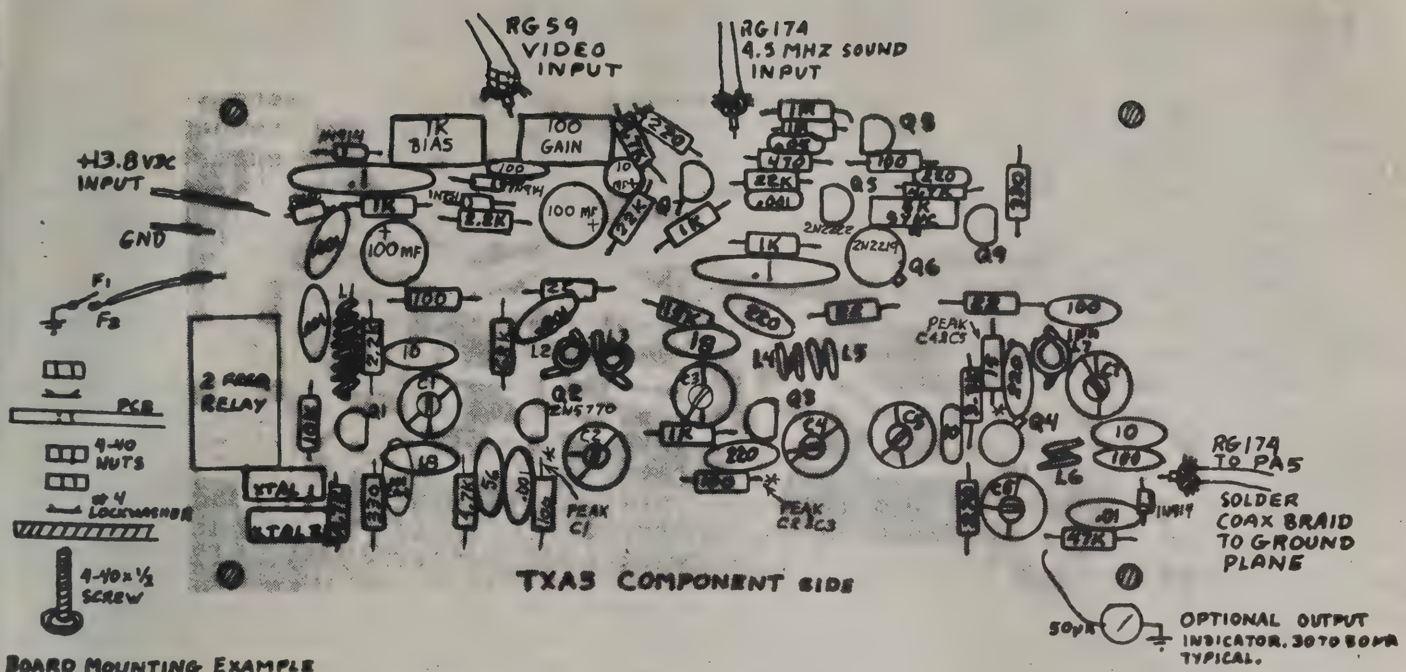
Keep all leads short as possible and shielded. RF coaxes must not have the center conductor out of the shield for more than 1/4 inch or risk instability from VSWR. Monitoring your own signal on a converter may give a false indication due to overload and multipath. Have a station over a mile away talk your picture in for you on two meter FM. (usually 146.43 or 147.51 simplex are used for coordination) It is normal for a average reading Bird Wattmeter to read 5 to 8 watts out with video applied and 10 with no video. PEP is still 10 watts due to the modulator sync clamping, but the average power will change with the average picture contrast level (APL).

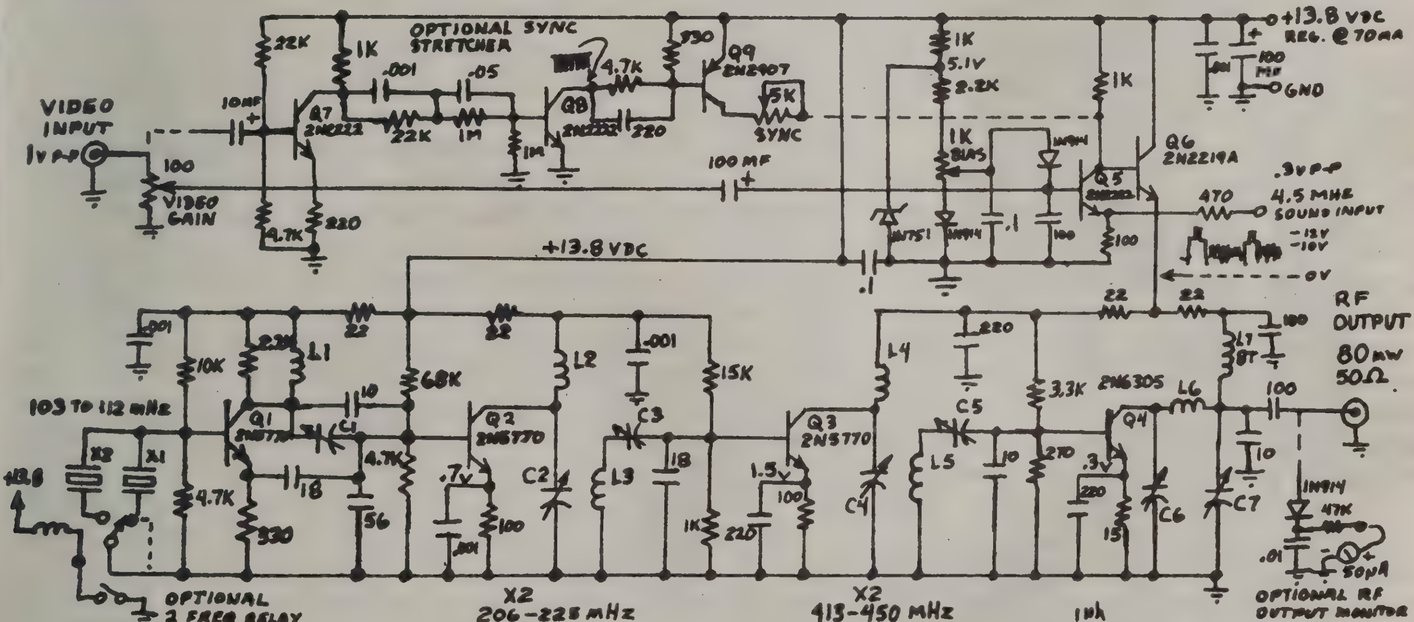
TYPICAL ATV STATION SETUP:



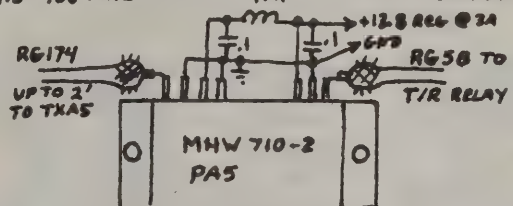


P. C. Electronics 2522 Paxson Ln Arcadia CA 91006 213-4474565





TXA5 SCHEMATIC DIAGRAM



All 50 ohm coax connections are made by dressing back the shield 1/4" over the outer jacket and then stripping the center conductor back 1/8". Carefully solder the braid to the ground planes with no mechanical pressure to prevent shorting from melted insulation. If any RF instability is noted check for VSWR. If PL259 connectors are used, construct using the outline in the ARRL Handbook. That is make sure the braid is continuous and tight right up to the center dialectric cut. Do not fold back. Solder the braid thru the holes. Keep RF coax leads away from the modulator section. A 220 pf cap may be necessary at the video input connector to keep stray RF from going up the Camera coax. All RF coax is 50 ohms and only the Video input is 75 ohm. Use only good broadband resonant 420-450 mHz 50 ohm antennas.

P. C. ELECTRONICS 2522 PAXSON LN ARCADIA CA 91006 213-4474565

TXA5-4B
W6ORG

SYNC STRETCHING THE TXA5 ATV EXCITER/MODULATOR.

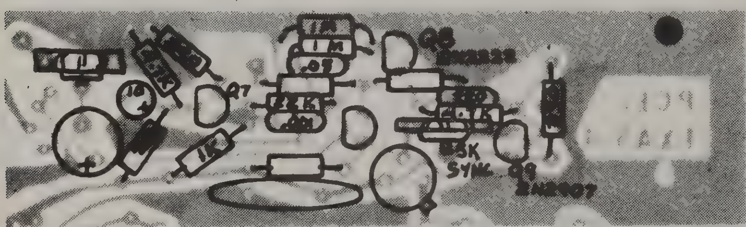
By W6ORG

The sync stretcher circuit on the TXA5-4B exciter modulator can be installed for those who want to accurately set the video to sync ratio at the nominal 10 watt PEP out of their TC-1 or PA5, or to compensate for the gain compression found in most amateur transistor high power amps. You may install the parts and tune up yourself if you have a oscilloscope and a DM-1 or other RF detector on the antenna RF output or have P. C. Electronics do it for you...see latest catalog for prices.

Refering to the TXA5 sheet, the full video input is capacitivly coupled to a video amplifier, Q7, for a voltage gain of 5. If the nominal video input from a camera is 1 volt p-p, then a good low distortion, negative going sync pulse will appear on the collector of the sync detector transistor, Q8. The time constants of the resistor and capacitor network between Q7 and Q8 were chosen to prevent noise and average picture level (APL) changes from falsely triggering the sync detector. Q9 inverts the sync pulses and pulls up the voltage on modulator amplifier Q5 toward the 13.8 V supply thru the 5K pot only during sync time. During video time, Q9 is off and has no affect.

The 5K stretcher pot will then pull the power output up above the 10 watt setting of the 1K bias pot to the limit of the full power capabilities. In some cases this may still not be quite enough to give 30% sync to 70% video on the scope from the detected RF output of the DM-1. Therefore the blanking or black level may be better set by adjusting the 1K bias pot additionally. Do not be disturbed by the lower average power read on a Bird wattmeter, the PEP (peak envelope power) is acutally higher and will be constant regardless of light or dark contrast scene changes (APL). Set video gain pot to the point where a very white part of the picture is just about to limit on the scope. Off the air reports should show that the pictures are more stable, especially if recorded on a VCR, and have equal or less snow content eventhough the average reading Bird Wattmeter may show a lower than normal reading.

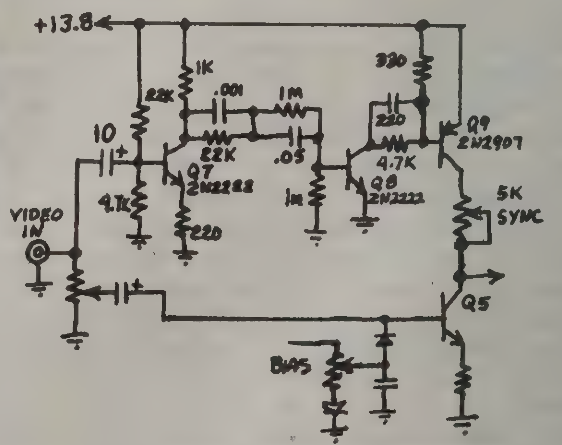
The layout is very crowded. It was added to existing production artwork to save time and costs. We suggest starting at one end and adding parts progressively across to the other end to prevent putting a part in the wrong hole. Do not substitute other values or so called equivalents for best results..........W6ORG (c) 12/81



COMPONENT SIDE

ONLY ADDED PART VALUES ARE SHOWN.

Resistors:220,330,1K,(2)4.7K,(2)22K
,(2)1M. 5K trimpot.
(2) 2N2222 npn, 2N2907 pnp.
Caps: 10 mf radial, discs:220pf,
.001. .05 may be disc or mylar.



PART OF TXA5 MODULATOR

P. C. Electronics 2522 Paxson Ln Arcadia CA 91006 213-4474565

PA5 10 WATT ATV LINEAR AMP

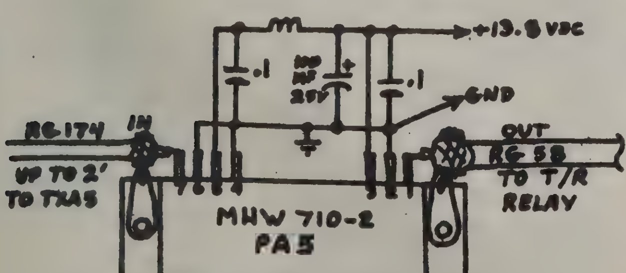
The PA5 is built around the Motorola MHW-710-2 hybrid power module. The input and output is 50 ohms. For 10 watts output, only about 80 milliwatts of drive is required which is supplied by the video modulated TXA5 Exciter. Other exciters may be used as long as the drive does not exceed 200 milliwatts, as permanent damage could result from over drive.

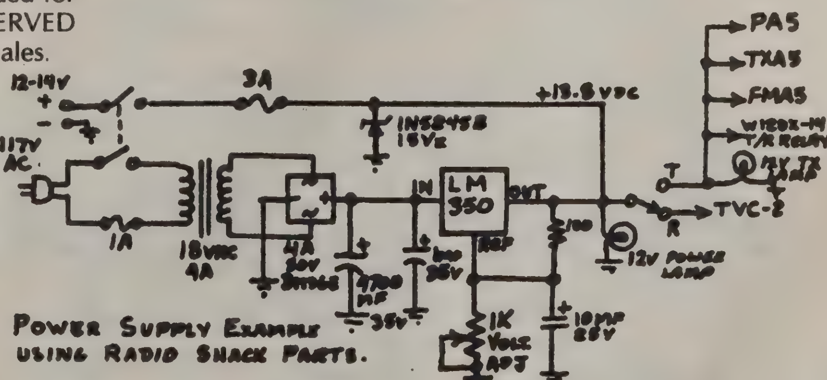
Power supply requirements are a regulated or low source impedance supply between 12 and 14 VDC capable of up to 3 amps. A power supply example using Radio Shack parts for 13.8 VDC at 3 amps is shown. For mobile or portable use, a standard 12 volt car battery may be used as long as the 3 amp fuse and 15 volt zener are put in the line to protect the power module from charging spikes. Voltages over 16 VDC can also cause permanent damage. If the power supply leads are over 1 ft long, add a 4700 mf 35 v in the line within 1 ft of the power module. Even the #18 or larger wire used for the power leads have enough inductance and resistance at the video modulation frequencies to cause waveform distortion unless well filtered.

The power module is capable of over 15 watts, but is not linear enough for ATV above 10 watts. Overdriving above 10 watts will only result in sync and black compression. This will give a jittery and unstable picture at the receive end. If more power is desired, add our modified Mirage D1010 amp, use lower loss coax or bigger antenna.

To set up, adjust the bias pot on the TXA5 exciter for 10 watts output on a Bird wattmeter with the camera or any video disconnected. This will set the blanking level at 10 watts. If you do not have a watt meter with the proper slug (Bird 25E), a rough setting is about 2.3 amps at 13.8 vdc. Set the sync expander pot to about 10 degrees from full (clockwise). Connect the camera and increase the video gain pot to the point of white compression and then back off a little. Too much video gain will chop up the 4.5 mHz sound subcarrier at the sync rate resulting in a buzz in the audio. The carrier is essentially cut off during any extreme white portion of the picture. The current draw and average power reading on the power meter will drop to between 6 and 10 watts depending on the camera and what is in the picture. This is normal and the peak envelope power will actually be around 12 to 13 watts on the sync tips due to the sync expander in the TXA5-4B modulator.

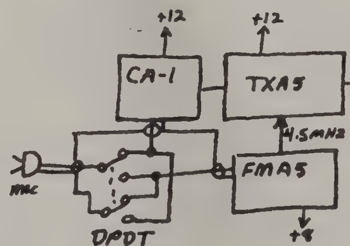
Make sure that the antenna and coax system have a low vswr, less than 1 watt reflected, to prevent the reflected power from radiating within the chassis and causing instability. Also keep the input and output coax separated by at least 2" to prevent feedback oscillation.

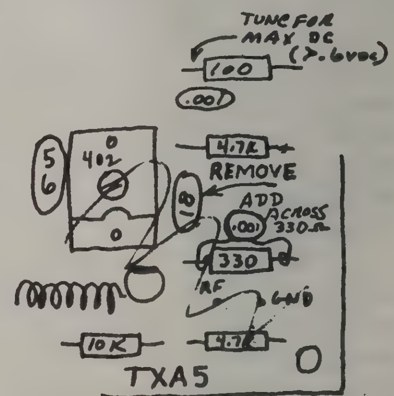


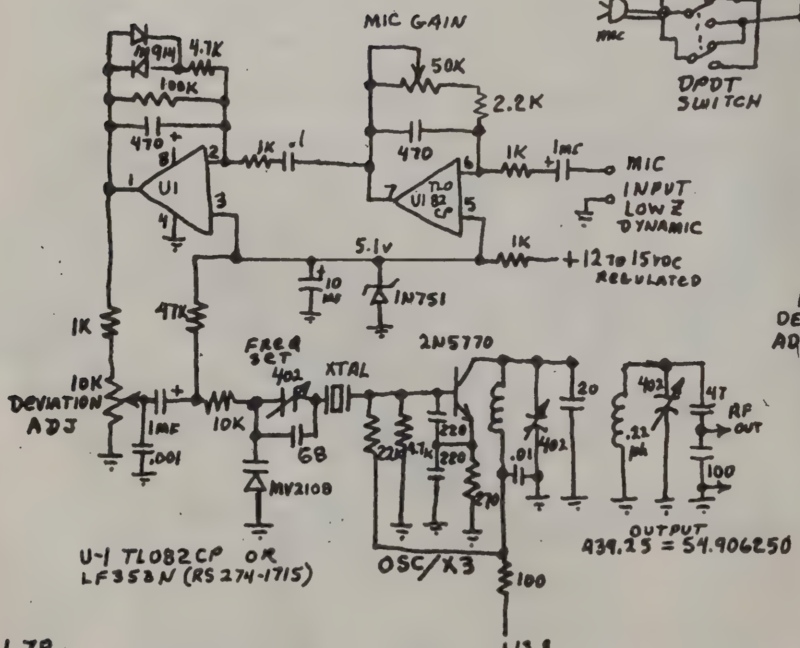


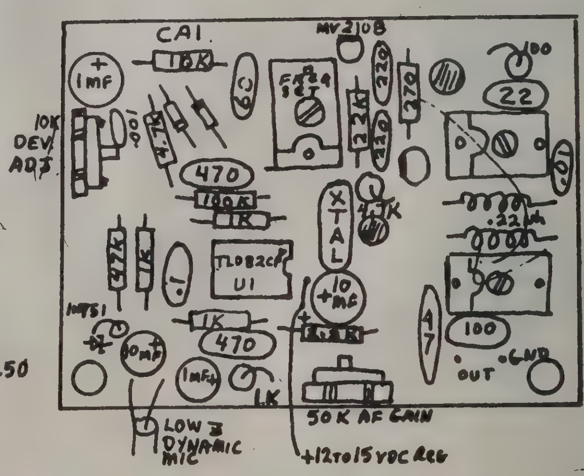
CA-1 FM CARRIER GEN

This module is designed to provide FM audio on the fast scan ATV TXA5 exciter. This is only necessary in those areas of the country that have a inband ATV repeater. These type of repeaters must use filters that are too narrow to pass the 4.5 mhz subcarrier and 3.58 mhz color subcarrier. To get around this the AM modulated video carrier is also FM modulated with sound. The standard repeater input is 439.25 MHz. A crystal can be ordered from Savoy Electronics (pob 5727, Ft. Lauderdale, Fl. 33310) for only $4.50 if specified for 2 meters..so 439.25 divided by 3 = 146.415 aproximately. Crystal type is their # 820.transmit. Any other frequency can be done the same way. The fundamental freq is 18 mHz and the module multiplies it by 3. The TXA5 xtal oscillator is changed to a doubler by removing the crystal, 18pf feedback cap to the emitter, and adding a .001 bypass cap from the emitter to ground. The board mounts directly above the TXA5 using 1"spacers and 4-40x1½" long screws. The CA-1 output has buss wire jumpers directly down to the old TXA5 crystal holes. A dpdt switch can be used if both subcarrier and on carrier sound are desired. Only one should be modulated at a time and the unused one grounded. The b+ lead from the CA-1 must be run all the way to the T/R switch to keep the common lead pickup to a minimum. The audio amp has a lot of gain to enable pickup to 20 feet and as such is very sensitive also to RF fields and lead pickup. Always use the minimum mic gain necessary. Start by setting the deviation control to minimum. Adjust the crystal freq cap to the right freq using a counter. Then adjust the deviation pot to the desired amont by talking into the mike. Nominal deviation is 5 kHz. The microphone can be any dynamic type with a impedance of up to 1K. Do not use amplified mics as there is a highgain compressor amp built in to the module.









FMA5 ATV SOUND SUBCARRIER GEN

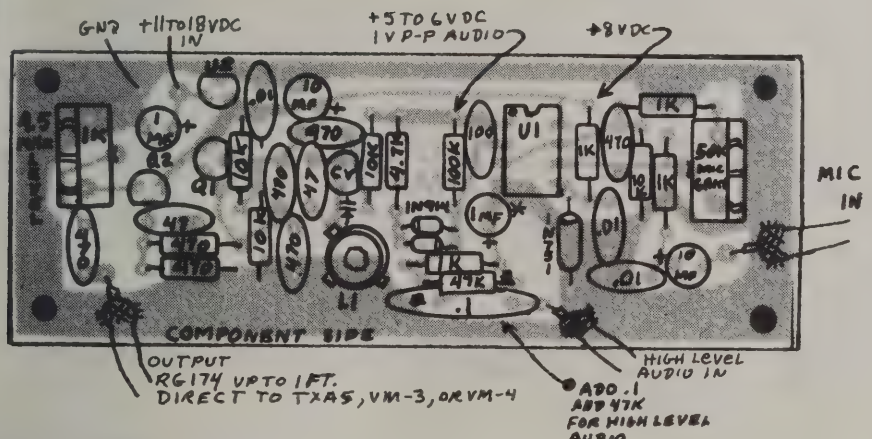
This module will enable adding sound with the video for ATV. It generates a 25 kHz FM modulated 4.5 mHz carrier to be mixed with the camera video for audio reception on a standard TV set.

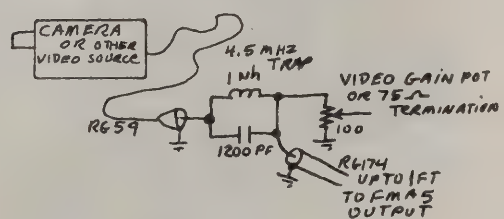
The output is adjustable up to 1 V p-p and can be directly connected to the 4.5 mHz input point on the TXA5 exciters or VM-3 and 4 modulators. Other modulators such as with the VM-2 or with TV rf modulators for computer video can also be used if a 4.5 mHz trap is inserted in line at the modulator as sketched below. This is necessay to keep the capacity of the camera or computer and the coax feed from loading downthe 4.5 mHz signal. The xmtr or RF modulator must be capable of passing 4.5 mHz. Most all transistor type transmitters have wide enough bandwidth but some tube types do not.

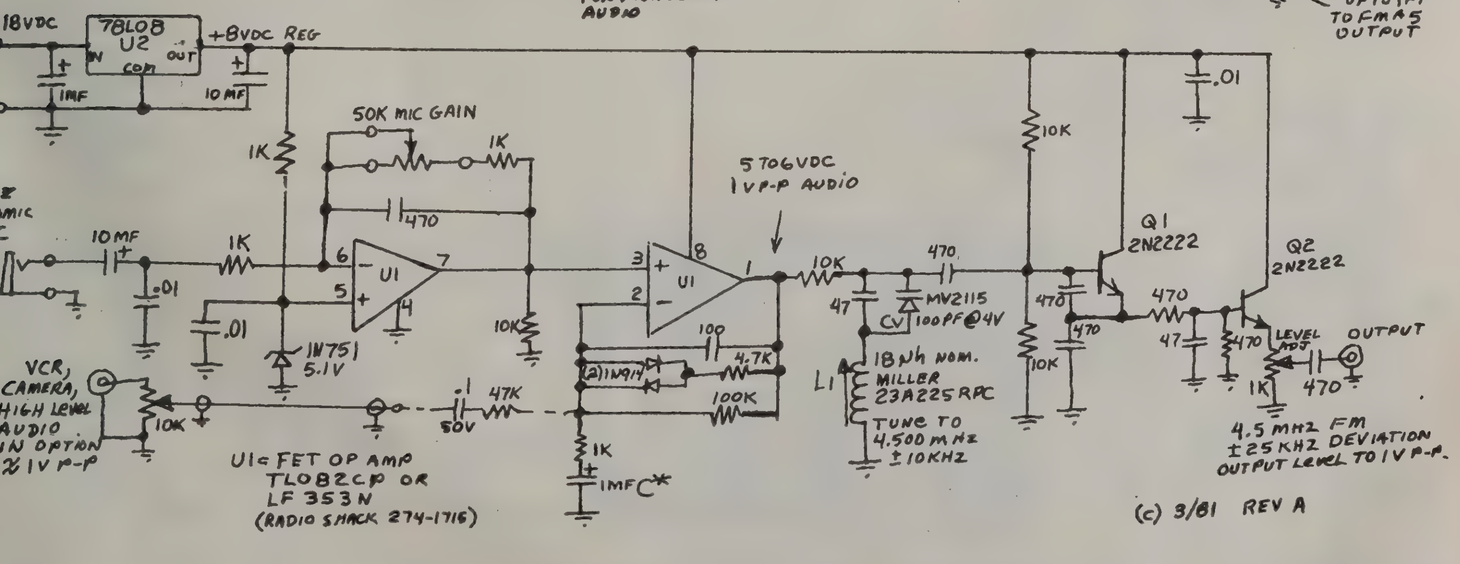
The mic amp has lots of gain to enable walking around with the camera up to 20 ft from the mic at full gain. With this high gain the xmtr RF can feed back into the op amp, so its best to shield this module in a box such as a LMB777. The osc coil is set to within 10 kHz with a freq counter. Audio response is 300 to 3000 hz for communications. For more treble the value of C* may be lowered down to .1 if desired. Also high level 1 v p-p audio from a VCR or repeater can be mixed in by adding the 10K pot, .1 mf, and 47K resistor shown to U1 pin 2.

Use any good 150 to 600 ohm non amplified dynamic mic. Radio Shack has a variety of tape recorder mics that should work well.

50K mic gain pot may be removed and replaced by a 50K panel pot with a shielded pair of wires run to it. Ground shield only at the board.







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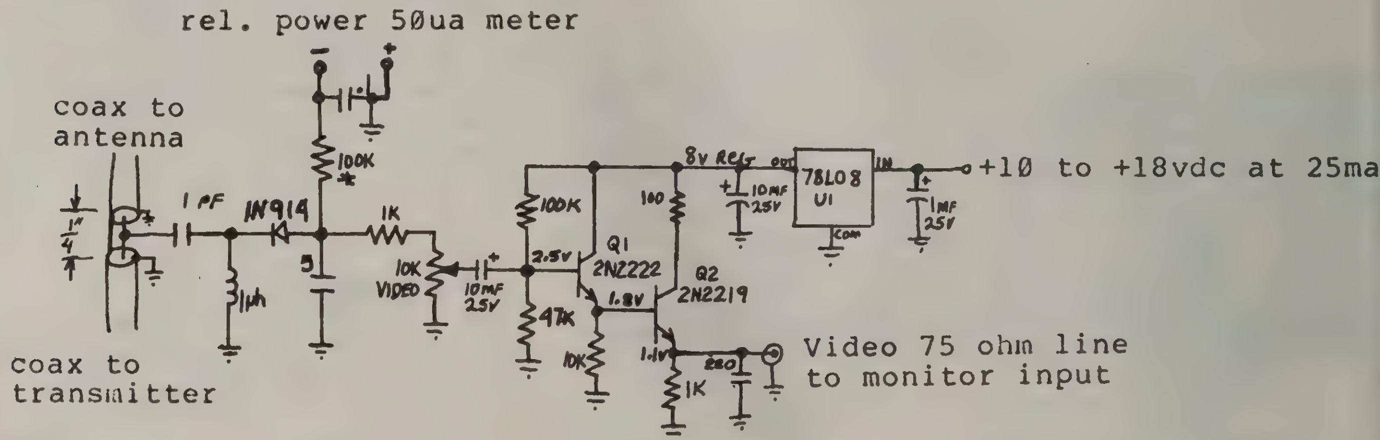
DM 1 VIDEO DETECTOR AND MONITOR

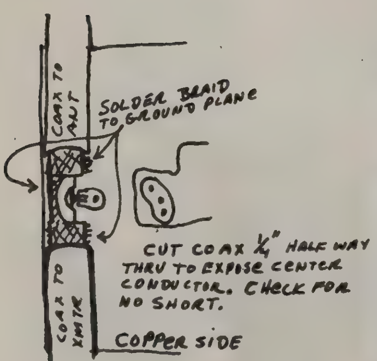
The DM-1 module will give a relative power indication for transmitter tuneup or monitoring, and also demodulate and drive a video monitor 75 ohm or loop thru input.

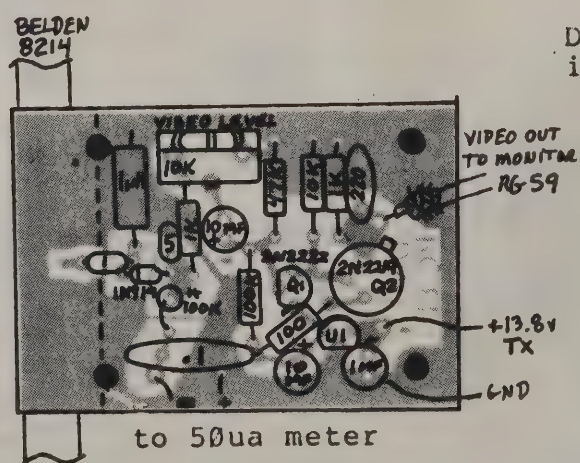
Receiving your own signal thru a converter or 2nd harmonic around CH 80 may give a false indication due to front end overload and multipath reflections. Just walking around in the room can make the picture jump. By detecting the antenna coax RF, and putting it into a video monitor you will see what's really going out on the air.

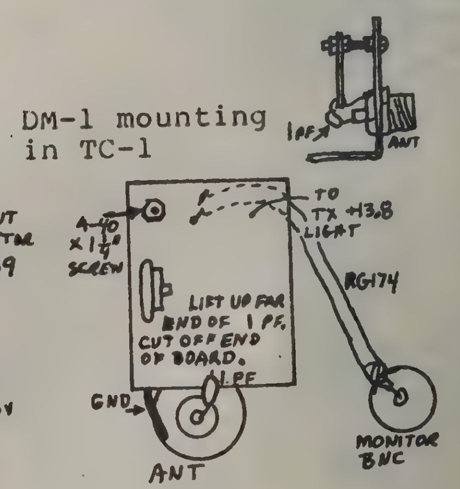
The module can be placed on a piece of the antenna line coax or mounted right over the antenna coax connector in the transmitter chassis. Take extra care with the connections to the RF as any lead length more than 1/4" can give VSWR and RF instability from radiation. As the sketch shows, cut a small "U" shape anywhere along the line no longer than 1/4", down thru the braid and dialectric to the center conductor. Expose the braid for another 1/4" on each side to enable soldering to the DM-1 ground plane. Make sure there is no mechanical stress on the coax when soldering so that the dialectric does not melt thru and short out the line. Solder a short piece of buss from the 1 pf cap pad to the center conductor.

Adjust the 10K video level pot for 1 volt peak to peak video output to the monitor. (about half way for the normal 10 watt pep rig) For the relative meter output any VOM can be used or a 50 microamp meter. (Radio Shack 270-1751 or equiv.) The meter can be calibrated against a accurate wattmeter by adjusting the value of the series 100K.*









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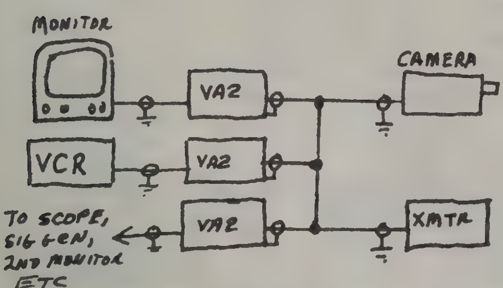
VA2 VIDEO DISTRIBUTION AMP

The two main functions of this module are to buffer off a 75 ohm line without loading it down to drive other monitors or devices, and to convert TV sets into video monitors or ATV repeater receivers. Video lines must be treated just like a transmission line and antenna. If the 75 ohm line is not terminated in 75 ohms, then the resultant VSWR fill cause ghosts and poor color. Usually the xmtr is the resistive termination at the end of the video coax. Taping on to the line with another monitor or 75 ohm load will give a VSWR, but with this modules input impedance being over 2K no significant effects will occur. Up to 8 VA2 modules can be taped into the line. See the distribution system sketch below.

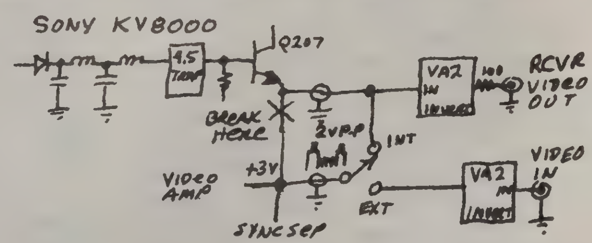
Video lines are 1.0 V p-p negative going sync into 75 ohms. But in some cases the level may be too low or the device to be driven such as a TV/monitor may need up to 2.5 volts p-p, or take positive going sync. The 1K pot may be adjusted for the desired output level and has a voltage gain range of 2 to 3. Max input is 1.5 v p-p. The output must be terminated at the end of the 75 ohm coax with a resistive 75 ohms to work properly. Make sure that the device to be driven has this temination with a ohmeter and also that it has no voltage present at the input connector before attaching the coax line. If there is voltage present use a series 100 mf cap (observe proper polarity) and add a 100 ohm resistor to ground from the connector center pin. Also check for proper polarity of the 100 mf VA2 input cap with respect to the line being taped into. Reverse it if the line DC voltage is above 2.4 v.

Use RG59 coax for runs over 2 ft for inter connections or to video sources and loads. RG 174 is fine, or shielded cable for shorter runs. Connect to any supply between 11 and 18 vdc at 25 ma per module. Solder in a buss wire jumper between hole "J" and either the non inverting (+) or inverting (-) hole as your application requires. Adjust the 1K video gain pot for a 1 v p-p output.

DISTRIBUTION SYSTEM



SAMPLE TV/MONITOR CONVERSION



R9 MAYBE PARALLED WITH 22K TO GIVE +3VDC OUTPUT TO RESTORE THE BIAS LOST FROM BREAKING Q207 EMITTER LEAD.

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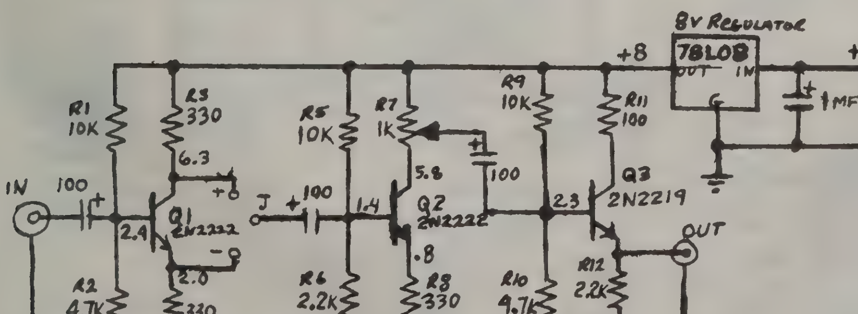
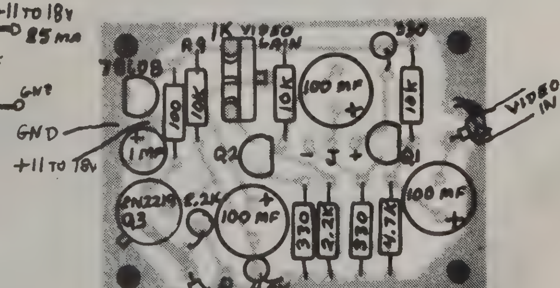




TSQ 1 ATV S-METER AND SQUELCH

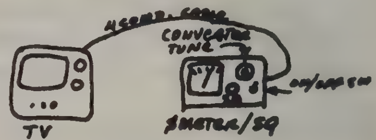
This circuit will enable better alignment of the beam and save the ears during long periods of monitoring. It was designed to be adaptable to any television...thats why so many pots! 4 connections are made to the TV set which are both easy to do and dont require cutting or modifing the circuit. The hot side of the speaker line is just cut and looped thru the relay and switch contacts. The other two leads are ground and the <u>video</u> IF agc line. Most agcs have a fast attack/slow decay RC circuit that must not be loaded down. Therefore a high Z fet input op amp is used. All part numbers are radio shack. It can all fit in one cabinet and still have room for a 434 or 1200 converter tuning control. Do not use on hot chassis! Use a isolation transformer for atv anyway to be on the safe side.

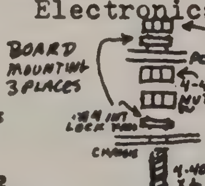
Find and measure the video IF agc voltage with no signal in and then with a very strong signal such as channel 4. If the voltage increases with increasing signal connect to the positive agc input...the negative is left open. If it decreases connect to the negative agc input and jumper the wiper of R1 to the positive input. Before appling power preset R1,R3 to center and R2, R5 to max resistance. Now set TV off 434 slightly or with no antenna for the no signal setup. Set R3 for the same voltage at the wiper as measured at the agc input. If negative going agc is used also adjust R1 for the same voltage at pin 1 of the op amp as the agc. Note the meter, it should read about zero, fine adj with R3. Now tune to a very strong signal and set R2 for full scale. Now check squelch range. Depending on the agc voltage change R5 will determine the squelchable range of the front panel pot/switch R4.

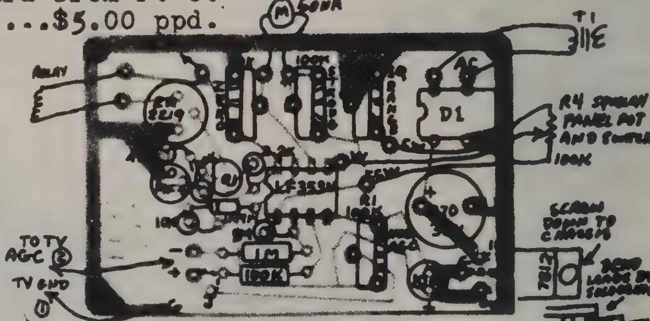
*This circuit will only work with agcs that do not go below 1.8 volts or higher than 11 volts positive.

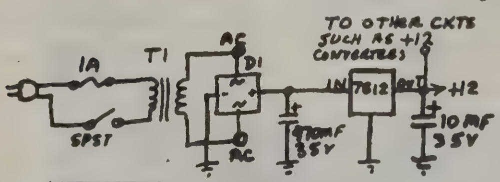
LF353N op amp	276-1715	Cabinet 4x2 3/8x6	270-252	
2N2222 tstr	276-1617	(2) 4 pin conn.	274-002	
2N2219 tstr	276-2030	(2) 4 pin plugs	274-001	
1N914 diode	276-1122	Mini SPDT Switch	275-603	
1A 50V bridge	276-1161	4 cond. cable	278-372	
12V 300ma T1	273-1385	Fuse holder	270-364	¼ w resistors
transformer		1 amp fuse	270-1273	10K 271-1335
470mf 35v cap	272-1018	3/4" knob	274-380	47K 271-1342
100K w/switch	271-216	7812 12v reg	276-1771	100K 271-1347
10K pot R3	271-218	6' ac line cord	278-1255	1meg 271-1356
100K pot R1,2	271-220			2.2K 271-1319
1meg pot R5	271-229			
12V dpdt relay	275-206			
50uA meter	270-1751			
10 mf 35v cap	272-1025			

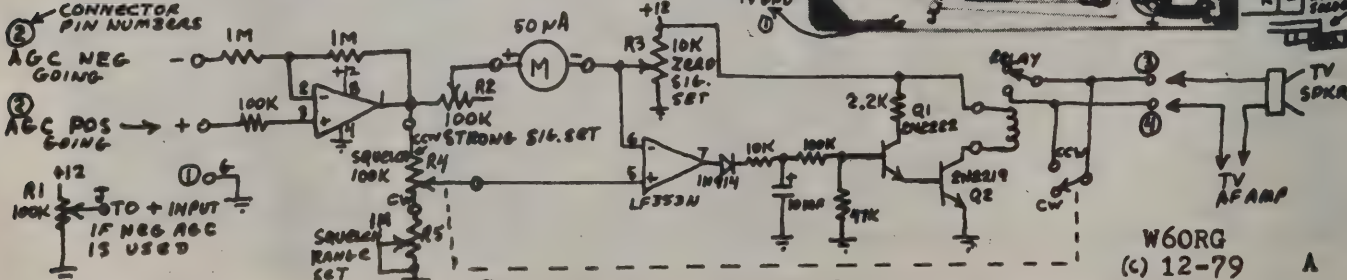
⊛TSQ-1 PC board from P. C. Electronics....$5.00 ppd.











W6ORG
(c) 12-79 A

⊛P.C. Electronics, 2522 S. Paxson Ln., Arcadia CA. 91006

TD1 TONE DECODER

The TD-1 Tone Decoder board is a simple circuit to close a DPDT relay upon receiving a horizontal sync or audio tone of atleast 100 millivolts. The values of C1, C2, and C3 shown are for between 11 and 20 kHz and may be directly scaled for any frequency in the audio range. The detection bandwidth is approx. + and - 5%. Power requirement is +8 to +16 vdc at 100 ma when energized.

The board accepts Radio Shack catalog parts but others may be substituted as size permits. The frequency and loop caps must be mylar or other stable types for stability. The 7805 regulator IC must be mounted to a chassis or heat sink if the voltage applied is greater than 9V.

R1, the 10K input pot should be adjusted to apply 100 to 200 mv of the desired tone to pin 3 of the 567. Overdriving with higher levels increases the possibility of sub harmonics and other tones tripping the relay also. With no audio or tone at the input, the center decoding frequency can be set with the 5K (R2) pot while monitoring the square wave at the end of the 10K resistor (R5, TP1) with a frequency counter. If no counter is available a rough adjustment can be done by applying the tone input and slowly turning the freq. pot (R2) and finding the two dropout points of the relay and then splitting the difference. The square wave on TP1 can also be used as a frequency locked signal to drive other circuits. The value of the 10 mf cap at pin 1 may be increased if a longer dropout time and better noise imunity are desired at the expense of pullin time. The example shown is for switching a relay upon detecting the horizontal sync frequency of 15734 Hz as a COR for ATV repeater systems. Other applications might include decoding one of the DTMF touch tones for special functions or selective calling. In this case the three cap values would be increased 20 times. Depending on tone levels and other signals on with them prefiltering may be required.

PARTS LIST (11 kHz to 20 kHz values)

Resistors ¼W	10K, 4.7K	RS 272-1051	.01 mylar cap C2
RS 271-217	5K trim pot R2	RS 272-1052	.047 mylar cap C3
RS 271-218	10K trim pot R1	RS 272-125	470 pf disc cap C1
RS 276-1721	567 decoder IC	RS 272-1406	1 mf tant. cap C6
RS 276-1770	7805 5V reg IC	RS 272-1025	10mf radial cap (2)C4,5
RS 275-215	5V DPDT relay	TD-1 Tone Decoder PC board from	

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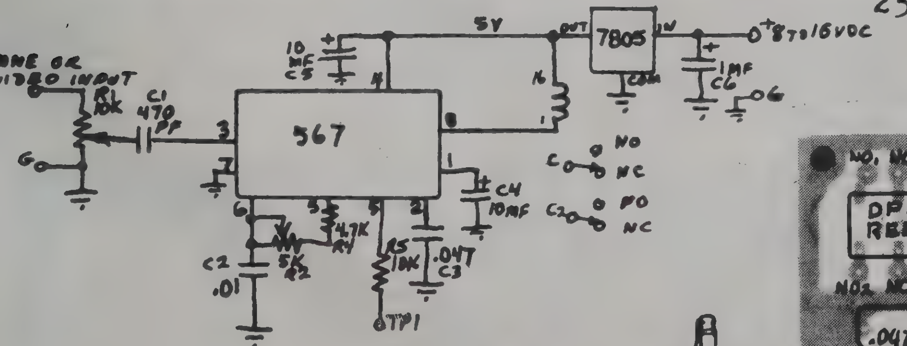
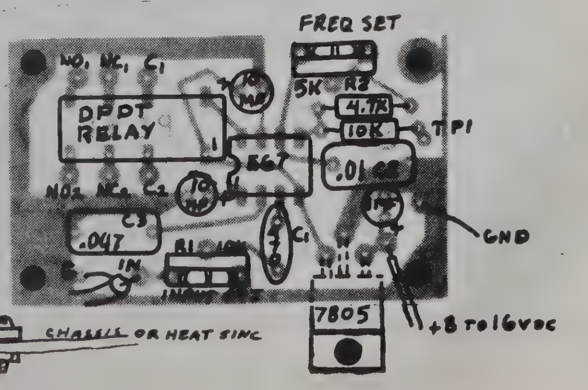
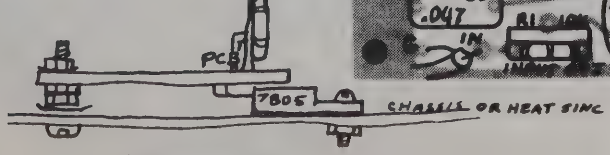


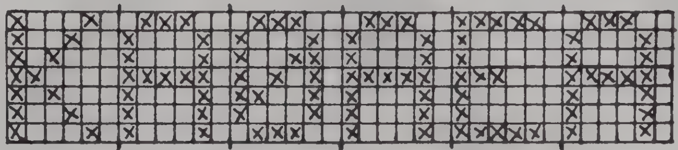




VID—3 VIDEO IDENTIFIER

The VID-3 Video Identifier board will enable superimpozing station call letters, or any group of 6 alphanumerics, or more depending on how well they fit in a 7 rows by 36 line dot matrix, upon the applied video. The alphanumerics are programmed in a SN74S188N 256 bit PROM. Each bit in PROM memory is clocked out serially on the ID Key Out at pin 10 thru a open collector buffer, U13. This key line pulls low the transmission gating circuitry on the VDM-3 board that does the actual superimpozing. Horizontal and vertical drive negative going pulses from the VDM-3 board start and position the alphanumerics within the picture. The position is determined by the pots connected to the dual one shot, U1.

X = LOGIC 1
BLANK = LOGIC Ø



Programming example: KAØAEA (Wichita, KS ATV Repeater). Make up your own on graph paper.

The dot clock, U3, is turned on and off by the position 1 shots keyed by the horizontal and vertical drives. Dot width is determined by the .001 mf mylar cap at U3 pins 2 and 6. This value can be varied some to widen or narrow the display. U4 divides the horizontal freq. by 2 which effectively makes the ID skip everyother horizontal line and thereby making the display a total of 14 horizontal scans high. If a smaller highth is desired, U4 can be removed and a jumper put between U4 pins 11 and 9. The horizontal freq. divided by 2 is also brought out to card edge pin 11 to enable making other superimposed graphics larger and more readable....the clock module for instance. ½ of U5 stops the dot clock when it recognizes 36 dots from dividers U6 and U7. The dot clock starts again after the set delay from the 2nd horiz. pulse. This will reoccur until all 7 lines are completed and the dot clock disabled by the other half of U5 recognizing 7 lines from divider U8. U11 serially outputs the data from the 8 Prom parallel outputs at the dot clock rate applied to divider U9. The Do of U9 and divider U10 change the Prom memory line output after each 8 dot clock bits until 32 lines later the end of 7 ID line gate stops the process and resets everything until the next vertical frame. U13 is a open collector buffer which pulls low during a valid ID dot. Up to 12 vdc thru a 1K resistor may be applied at this output and many other open collector outputs from other modules in parallel.

CONNECTOR: Pins 5,E must have a regulated +5 VDC supply.

A,1 Ground, power supply return
4 ID IN/OUT. ID active if grounded, disabled if open. TTL levels.
10 ID KEY OUT. active pull down. External pullup on VDM-3 board.
11 HORIZ. ÷2. TTL level 2 loads. Drives other effects modules.
17 HORIZONTAL DRIVE IN. Internal pullup to +5, pull to ground from VDM-3
19 VERTICAL DRIVE IN. " " " " " " " " "
20,X EXT VERT. POSITION. optional external 50K pot control such as on a front panel. Remove on card pot if used.
21,Y EXT HORIZ POSITION. optional external 25K pot control such as on a front panel. Remove on card pot if used.
Z,22 GROUND. Signal returns

Make sure card is plugged in correctly before appling power. Lettered pins are on the component side and numbered on the solder side. Connector is a dual 22 pin such as Radio Shack RS-276-1551.

For more than one prom, a jumper cable (RS-276-1976) can be plugged into the PROM socket and into the IDS-1 ID Sequencer module. The various proms will then be sequenced in the picture at a few second rate. If more than one at the same time is desired another VID-3 board may be paralleled.

Additional programmed proms are available for $15 each. Specify up to 6 alphanumerics or supply matrix sketch as KAØAEA example above.

$69 PPD

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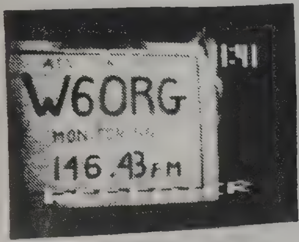
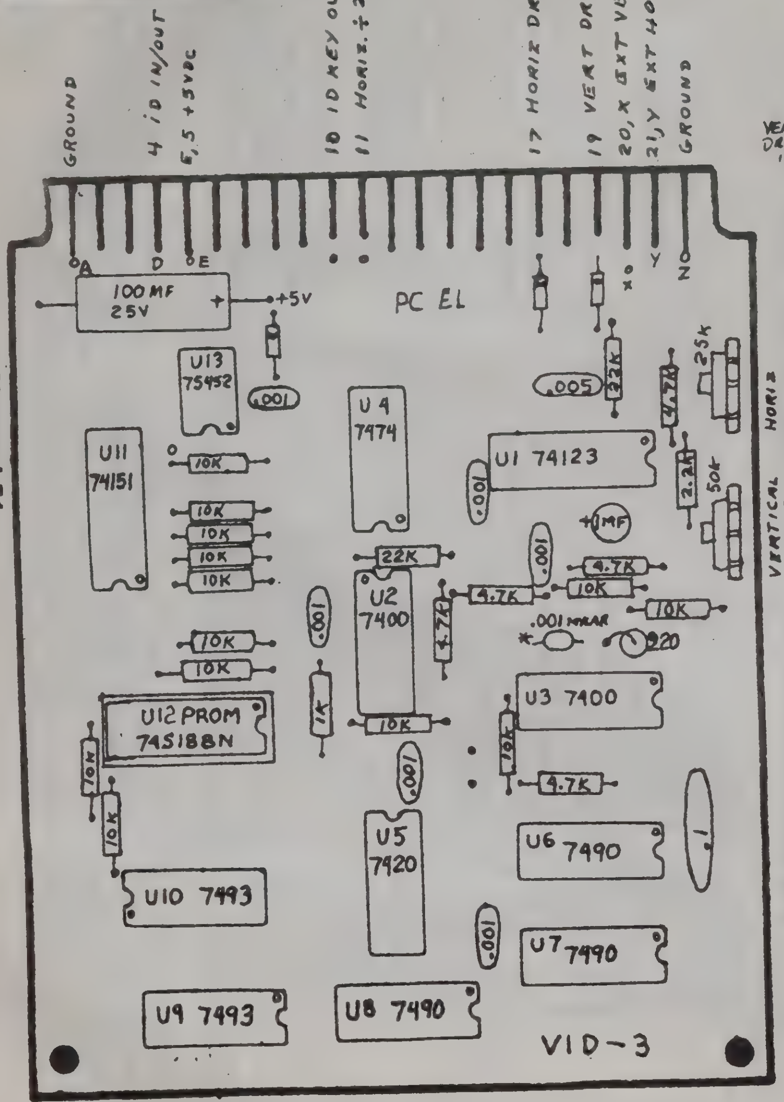
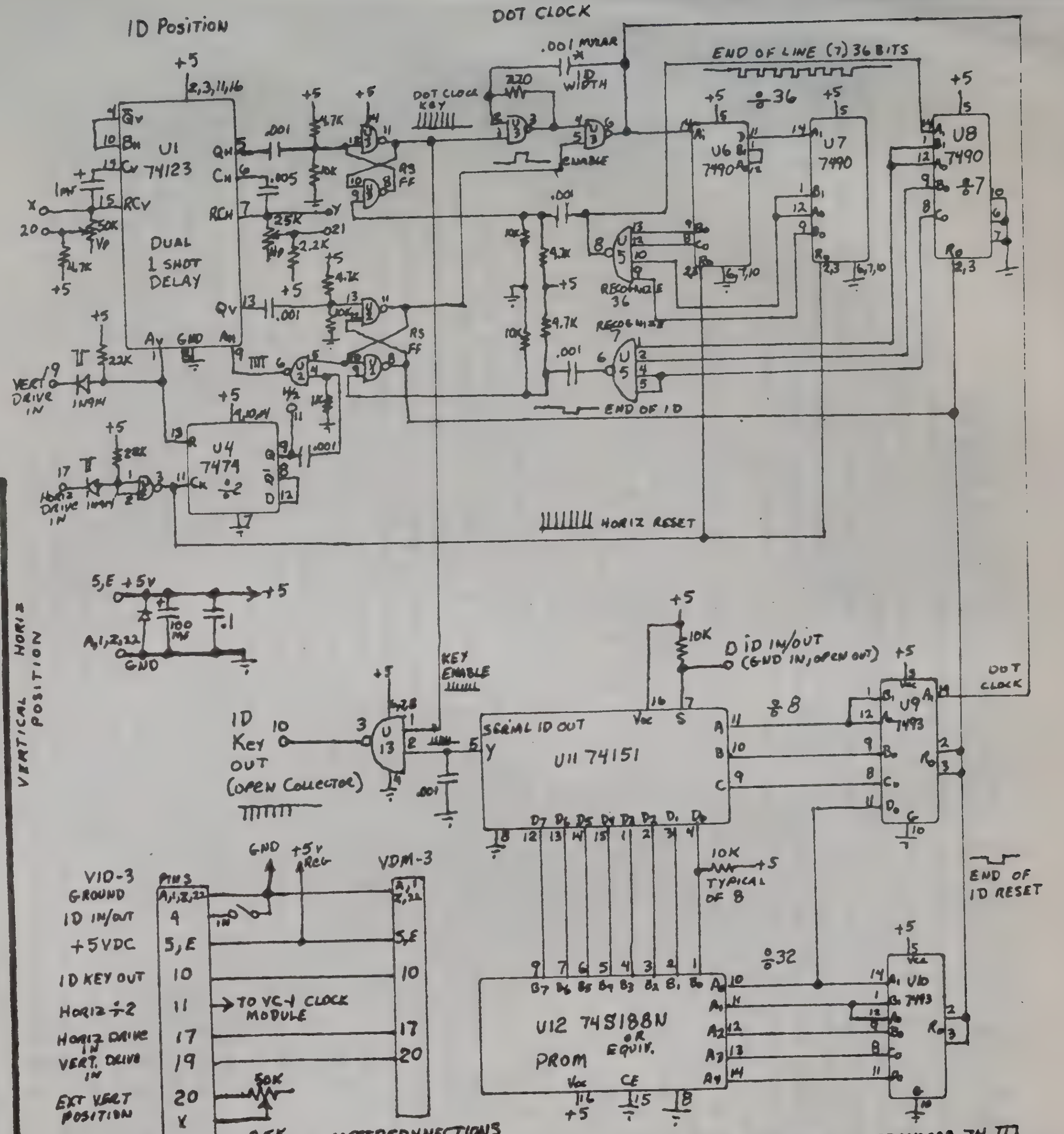
VID-3 VIDEO IDENTIFIER







IF EXT POSITION POTS ARE USED, REMOVE POTS ON PC BOARD. FILL PC POT HOLES WITH SOLDER.

74LS MAY BE USED IN PLACE OF STANDARD 74 TTL
U2,3 = 7400 U5 = 7420 U13 = 75452 DIODES: IN914
CONNECTOR IS RADIO SHACK RS-276-1551
DUAL 22 PIN. MAKE SURE CARD IS
PLUGGED IN CORRECTLY
BEFORE TURNING POWER ON.

W6ORG
1-81

VDM-3 VIDEO DISPLAY MIXER

The Video Display Mixer board contains: a two input switcher, inputs for keying in superimpozed alphanumerics, a sync separator with phase locked horizontal and vertical oscillators, two each horizontal and vertical pulse outputs for driving special effects and ID boards or for giving a raster with superimpozed ID on one of the selectable inputs, and at the users option the parts can be stuffed in the board for up to 4 v p-p vertical and horizontal drive into 75 ohm lines to a externally syncable camera for special effects.

U1 is a transmission gate which is used to select either of the two video inputs. The input is selected by a open on the active input and the other select line grounded. One of the select lines must be grounded. When the Key Input is pulled to ground with data pulses, the video input is switched out and a DC level set by a external pot (typ 3v) and or 3.58 mHz for color is switched in.

The sync separator and the drive outputs can be keyed from either the video on input 1 or by which ever input is selected by means of a solder jumper. The board is sent with jumper "1" which provides syncing all external boards to the video input on input 1. This allows use of the raster when switched to video input 2 or for a externally syncable camera. Jumper 1 can be removed and 2 jumpered if two separate nonlocked cameras are used.

The free running frequency of the phase locked loops are set to 60 and 15734 Hz by the 10K multiturn pots. They will provide drive output even if camera video is lost. Locking range is about 5% of the free running frequency. U3 sets the drive pulse width and is set for 6.3 us on the horizontal and .67 ms vertical. Solder jumpers are set for the phase lock oscillators (4 and 6) but direct sync keying can be used by removing the solder jumper and jumpering the direct inputs (3 and 5 see schematic).

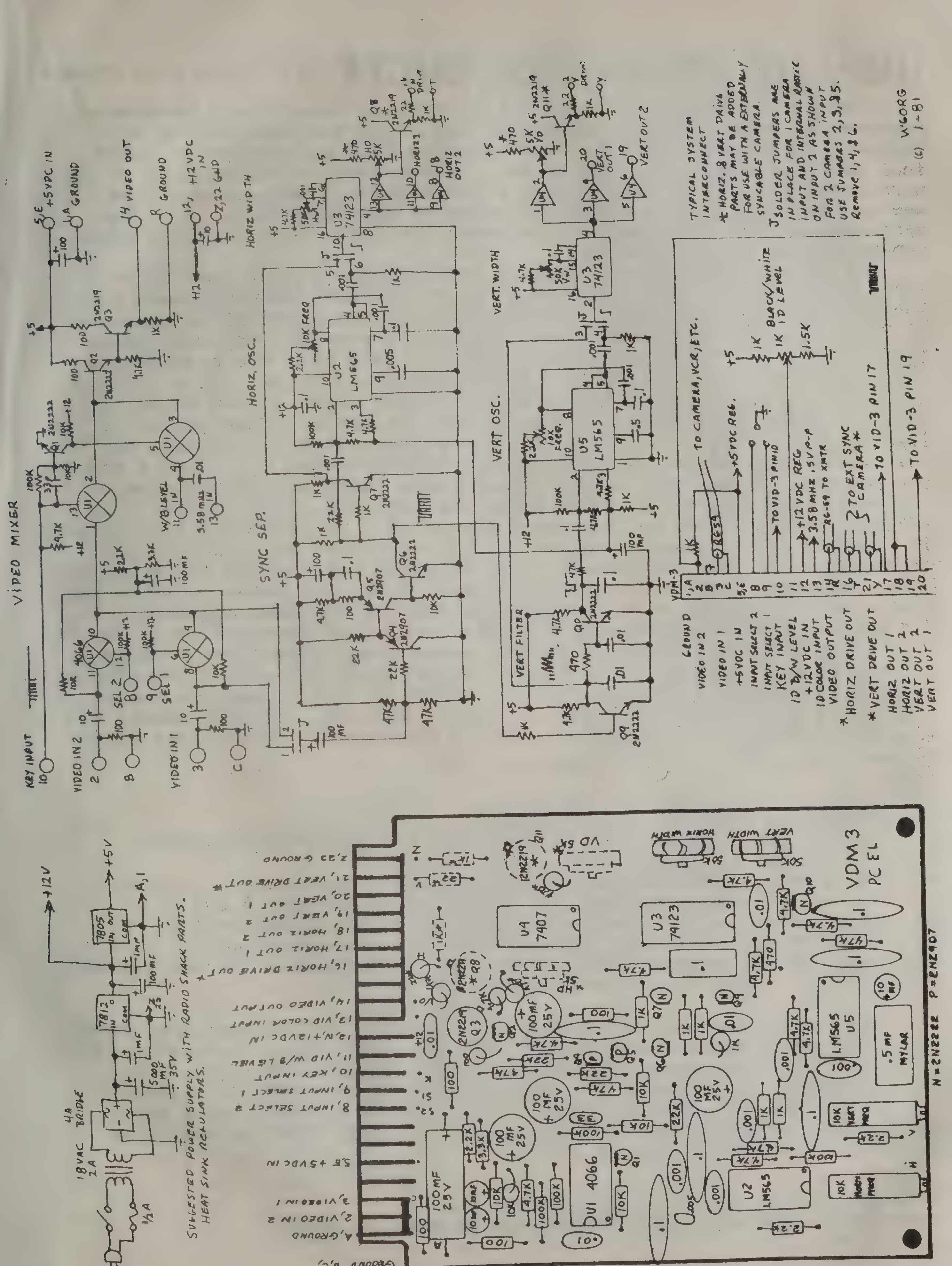
U4 is a hex open collector buffer for the drive outputs. 2 each 5K pots, 470, 22, and 1K resistors, and 2N2219 transistors can be added if a externally syncable camera is to be used. The 5K pots set the drive level up to 4 v p-p negative going. If not used another open collector out put is available with jumpers from U4-2 to pin 21 and U4-12 to pin 16. Pins 18 and 19 can be tied together and pulled up thru a 1K resistor to the +5v to provide a blanking raster input to video input 2.

CONNECTOR:

A,1	GROUND. power supply return
2	VIDEO IN 2. 75 ohm terminated. coax ground at pin B. raster input.
3	VIDEO IN 1. Primary video 75 ohm input. ground at pin C.
E,5	+5 VDC IN. Regulated +5 VDC input.
8	INPUT SELECT 2. Open active, ground off. Switch to ground between
9	INPUT SELECT 1. Open active, ground off. both inputs.
10	KEY INPUT. Superimpoze pulses pull to ground. 2 ma pull to 12V.
11	VID B/W LEVEL. 2.0 to 3.5V input for ID white to black shades.
N,12	+12 VDC. Regulated 12 VDC input
13	VID COLOR INPUT. 3.58 mHz up to .7 v p-p. Set b/w shade to grey. G@N.
14	VIDEO OUTPUT. 75 ohm terminate at end of coax. coax shield to R.
16	HORIZ DRIVE OUT. 4V p-p 75 ohms to ext sync. camera. optional. GND @R
21	VERT. DRIVE OUT. " " " " " " " " " . GND @Y
17	HORIZ OUT 1. pull down pulses to VID-3 and other modules.
18	HORIZ OUT 2. Same as above. May be used for internal raster with
19	VERT. OUT 2. jumper to horiz and vert out 2 and input 2. 1K to +5.
20	VERT. OUT 1. Pull down pulses to VID-3 and other modules.
22,Z	GROUND. Power supply and signal returns.

Make sure card is plugged in correctly before applying power. Lettered pins are on the component side and nombered on the solder side. Connector is a dual 22 pin such as the Radio Shack RS-276-1551.

P.C. Electronics, 2522 S. Paxson Ln., Arcadia CA. 91006


VIDEO MIXER
SYNC SEP.
HORIZ. OSC.
HORIZ WIDTH
VERT. WIDTH
VERT OSC.
VERT FILTER
TYPICAL SYSTEM INTERCONNECT
* HORIZ. & VERT DRIVE PARTS MAY BE ADDED FOR USE WITH A EXTERNALLY SYNCABLE CAMERA.
J SOLDER JUMPERS ARE IN PLACE FOR 1 CAMERA INPUT AND INTERNAL RASTIC ON INPUT 1 AS SHOWN. FOR 2 CAMERA INPUT USE JUMPERS 2,3,&5. REMOVE 1,4,&6.
W6ORG (c) 1-81
SUGGESTED POWER SUPPLY WITH RADIO SHACK PARTS. HEAT SINK REGULATORS.
COMPONENT SIDE HAS LETTERED PINS
VDM3 PC EL
N=2N2222 P=2N2907

IDS-1 ID PROM SEQUENCER BY W6ORG TOM O'HARA

The ID Prom sequencer module will step between 2 to 5 programmed prom memory chips over a adjustable time on period upon key up of a transmitter or other device. The sequence will automatically rekey at a selected later time period as a transmission time reminder or to meet legal station identification requirements. The sequence line can be opened to give a continual repeated sequence also. A 16 pin IC jumper ribbon cable connects between the IDS-1 board and the prom socket on the VID-3 board.

U1 is enabled when the voltage at connector pin 20 goes above 8 volts DC as is done if connected to the +13.8 vdc transmit power buss. The sequence oscillator is then turned on and supplies clock pulses to U3, a 12 stage binary divider. The 1 meg pot sets the oscillator frequency in the few hz per second range. This sets the actual time that one prom is on and is the osc. freq divided by 32. This divided frequency is applied to a 4017 decade divider which inturn sequences thru the proms until reset by the jumpers J1 and J2 connected to U2 and U4s reset input. If there are three proms then J1 connects to pad 3 of U4 and J2 goes to the following pad, number 4. J3 will restart the sequence on the fall of the square wave pulse out of the binary divider. Each pad around U3 divides the previous by 2. So pad 10 is pad 5 divided by 2 to the 5th power or 32. But since J3 is triggered on the fall of the wave it is one more division or 64. If this pad is selected and the incremental prom sequence rate is set for 4 seconds, then the rekey time will be a little over 4 minutes later. Pad 11 will give about 9 minutes then. At any time during the prom sequence, the hold line may be grounded and that particular prom will stay on. When the ground is lifted the normal sequence will continue. There are two open collector outputs available to turn off and on the display under this modules control. The VID IN/OUT on pin 4 goes low during sequencing and turns on the VID-3 output data on. In like manner but opposite polarity, the output on pin 13 goes open to enable the clock module VC-1.

CONNECTOR

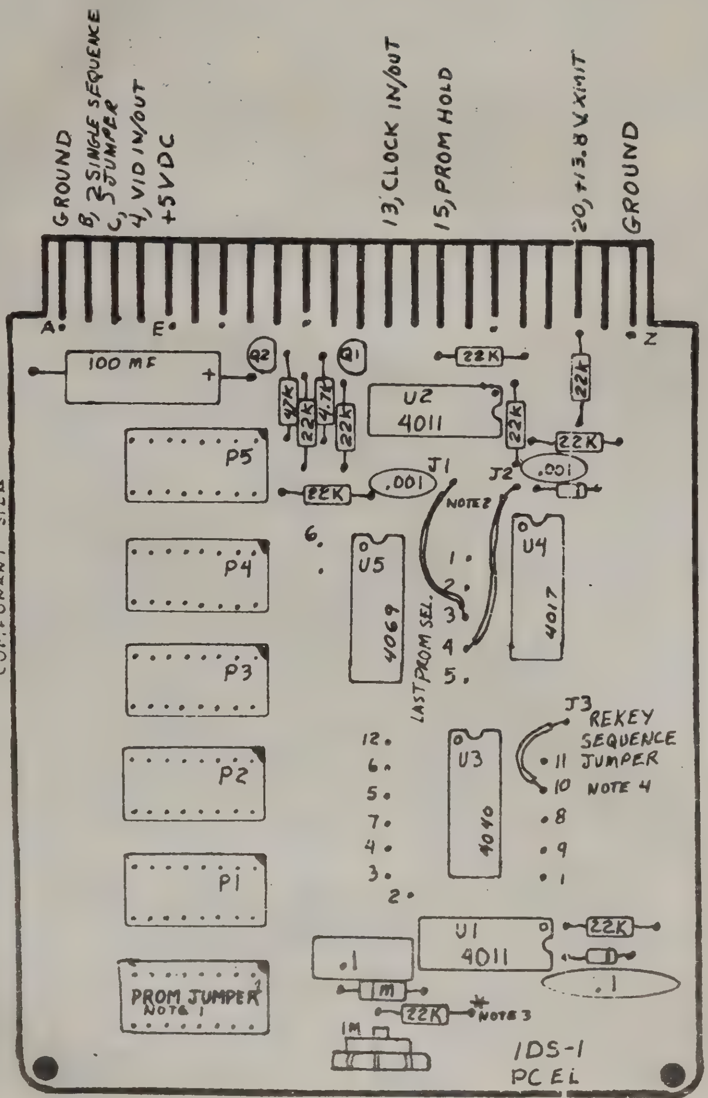
1,A	GROUND.	power and signal return
4	VID IN/OUT.	open collector pulls to ground during sequence.
5,E	+5vdc reg.	5V power supply input
B	J1 JUMPER.	external switch selects continuous (open) or one
C	" "	sequence and shut off (jumper between B and C).
13	CLOCK IN/OUT.	open collector goes open during sequencing.
15	PROM HOLD.	stops and holds active prom when grounded.
20	+13.8 XMIT.	greater than 8 volts starts sequence. ground resets.
22,Z	GROUND.	power and signal return.

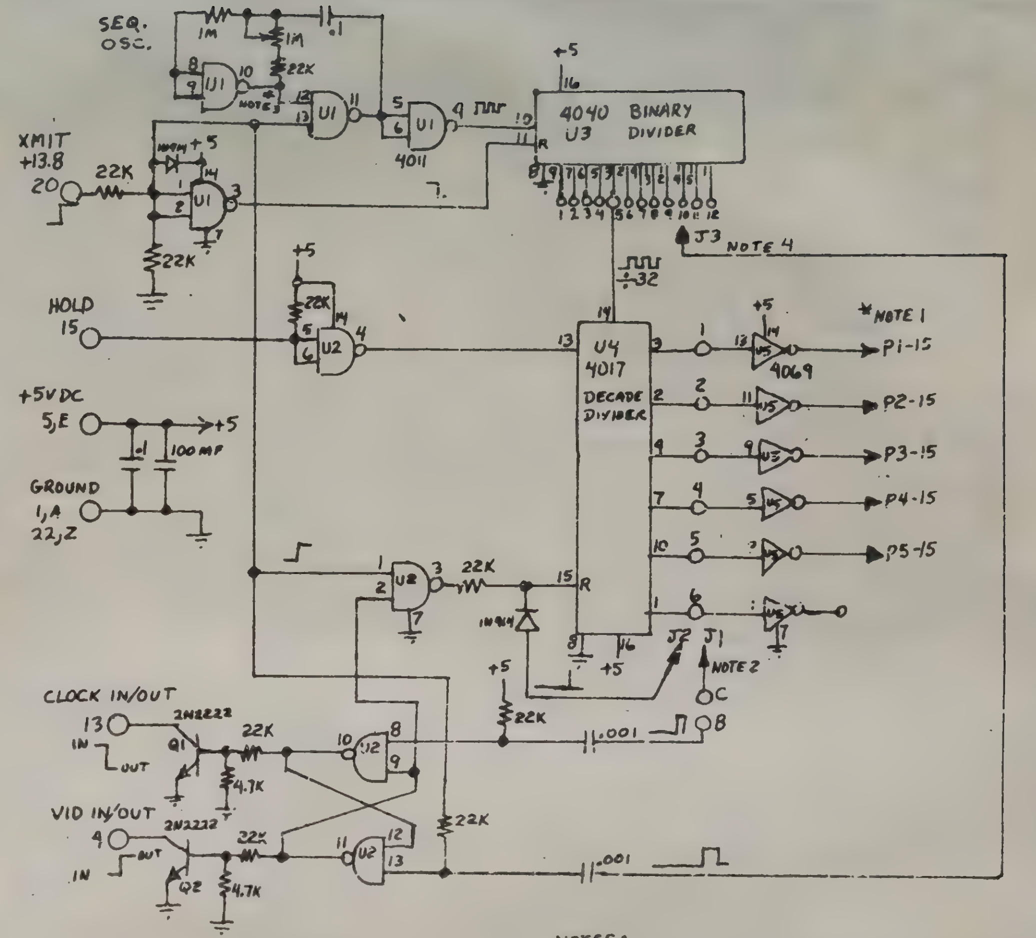
Make sure the card is plugged in correctly before applying power, the lettered connector pins are on the component side. Connector is a dual 22 pin edge connector such as Radio Shack RS-276-1551. The 16 pin ribbon cable jumper is a Radio Shack RS-276-1976 or equiv.

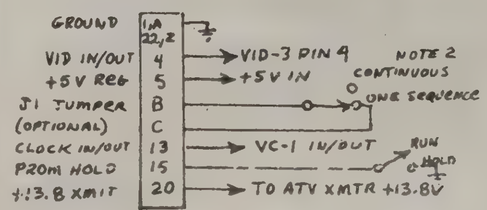
Additional programmed 256 bit (8x32) proms are available for $15 each. Specify the 6 alphanumerics or supply a matrix sketch as is found on the VID-3 module sheet.

P.C. Electronics, 2522 S. Paxson Ln., Arcadia CA. 91006

P.C. ELECTRONICS
2522 PAXSON LANE • ARCADIA, CA 91006
(213) 447-4565







JUMPERS ARE SHOWN FOR 3 PROMS, ONE SEQUENCE UPON KEY UP, 4 SEC/PROM, AND REKEYED ABOUT 5 MINUTES.

NOTES:

1. ALL PROM SOCKET PINS EXCEPT 15 ARE PARALLELED. USE 16 PIN JUMPER CABLE TO VID-3 PROM SOCKET.
2. JUMPER J1 CAN BE CONNECTED DIRECTLY TO THE LAST PROM NUMBER PAD OR WIRED THRU CONNECTOR PINS B AND C, TO ENABLE CONTINUOUS OR ONE SHOT SEQUENCING. J2 CONNECTS TO THE PAD NUMBER AFTER J1.
3. FOR ACCURATE TIMING A PERIOD COUNTER CAN CONNECT TO #22K RESISTOR. ADJUST 1M POT FOR DESIRED SEQUENCE TIME.
4. J3 SETS THE REKEY SEQUENCE TIME. EACH NUMBER AT U3 DIVIDES THE PREVIOUS BY 2.

PROM SEQUENCER. (c) 2-81 WGORG

AIM-3 AUDIO ID MIXER

The Audio ID Mixer board enables mixing up to 4 audios from radios, TVs, VCRs, computers, telefone, etc. with a MCW code ID. The mixed audio is available at the transmitter line output and at the .4 watt 8 ohm speaker output for setup and local monitoring.

The call letter ID and/or message is contained in the custom programmed PROM. The PROM is organized as 4 outputs with a 256 bit length. The sequence is started by a momentary ground at either of the negative code trigger inputs or 12 to 15 vdc applied to the positive code trigger. This will reset the 4024 binary divider to zero. Its outputs are the PROM address inputs. At zero, PROM output Q1 goes high enabling the code speed oscillator to clock the 4024 and the PROM thru the memory from zero until it goes back to low at the end of the code sequence. Also, one bit before the end, Q2 will go high for one bit to key any other device such as a voice clock to come on after the MCW ID. However Q2 and Q3 can be programmed for any output requested by the user for external devices that can be driven by one TTL open collector drive source. Q0 will turn on and off the code tone oscillator at the code speed rate set by pot CS. Pot CT sets the code tone and CA sets the amplitude. The ID must be retriggered for each new sequence as it automatically stops at the ID end.

Any audio may be applied to the 4 inputs, but 2 of the inputs, 1 and 4, have pots (1R and 4R) that enable just decreasing the level rather than turning it off. The 4 audio switch controls are on if open and off, or in the case of 1 and 4, are lower when grounded. These can be controlled by external switches or open collector logic from tone decoders or processors. Audio input levels must be at least 100 mv p-p for full output. Full output setting using pots A1 thru A4 should not go above .5 v p-p at the test point for least distortion. To prevent over deviation, a diode soft limiter is included for swings over .7 v p-p. Typically the primary audio is set for .5 v p-p, code audio about .25, and the others as desired. Its best to set them one at a time with the others off and then fine adjust to your ear using the speaker output. Set the deviation by adjusting pot TA to the proper level with a tone into the primary audio input set for .5 v p-p at the test point. Jumper C if connected to the high level input of the FMA5. If a mic input on a FM rig is used then select a low value for R that matches the mic Z and a cap value of 10 mf. The value of C can be reduced for treble boost or premphasis as desired. Also R can be reduced for lower output if the mic seems to be over driven.

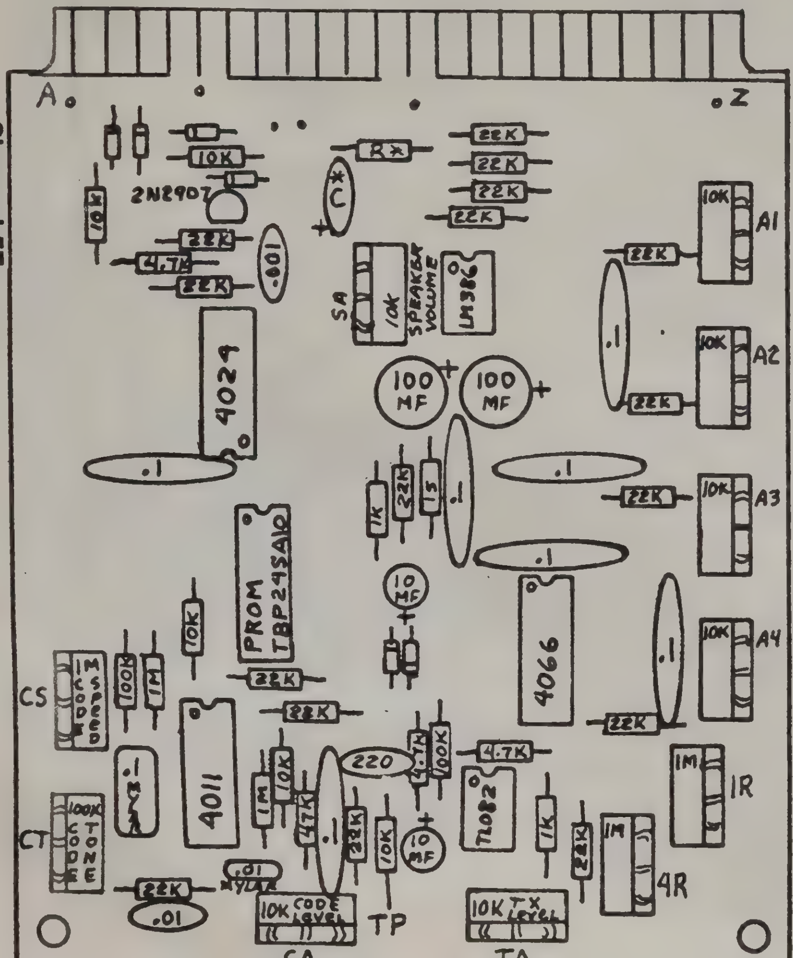
See the hookup example for a typical system interconnection. The 5 and 12 volt supplies must be regulated. The negative code triggers must be open or high and then momentarily taken to ground to key the ID. It can be held low but must be taken high and then low to retrigger. The positive trigger must be open or low and then taken up to 12 to 15 volts. This input is intended to trigger when the transmitter is keyed on. The prom Q2 and Q3 outputs are open collector and can be connected to key other devices at or during the code sequence. For example the Radio Shack Voxclock can be triggered thru a TIL119 optocoupler. The audio input switches can be left open if all 4 audios are to be run at the same time, or pulled to ground by a toggle or open collector switch.

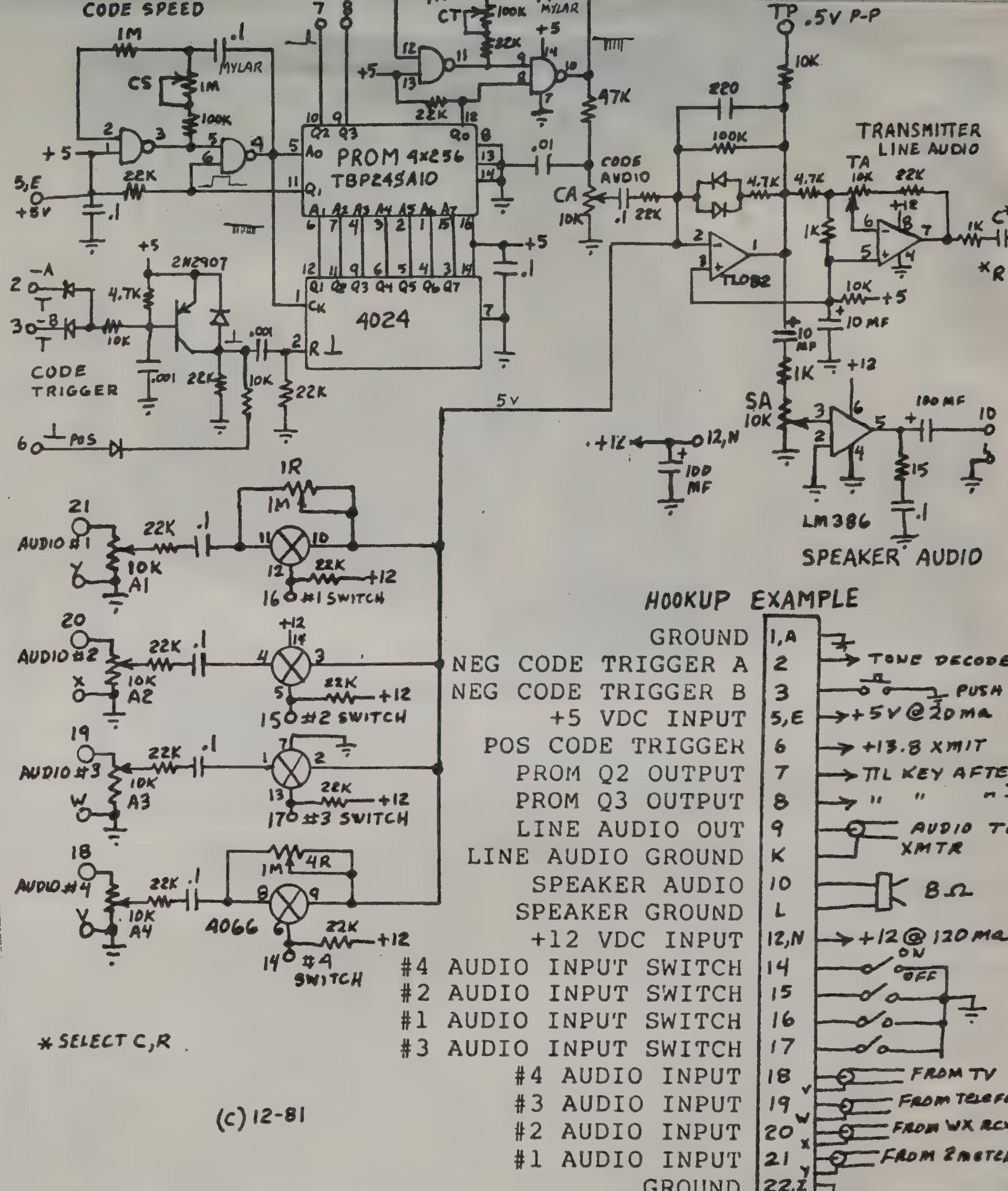
Make sure the card is plugged in correctly before applying power. Lettered pins are on the component side and numbered on the solder side. The Radio Shack RS-276-1551 dual 22 pin connector has the letters and numbers next to their respective solder pins.

The AIM-3 comes with one programmed PROM, but if a different call, /rpt, location, etc. or special bits programmed into Q2 and Q3 are desired, we can make one up to your specifications for $15 + $2 shipping and handling.

W6ORG (c) 12-81

1,A	GROUND
2	NEG CODE TRIGGER A
3	NEG CODE TRIGGER B
5,E	+5 VDC INPUT
6	POS CODE TRIGGER
7	PROM Q2 OUTPUT
8	PROM Q3 OUTPUT
9	LINE AUDIO OUT
10	SPEAKER AUDIO
12,N	+12 VDC INPUT
14	#4 AUDIO INPUT SWITC
15	#2 AUDIO INPUT SWITC
16	#1 AUDIO INPUT SWITC
17	#3 AUDIO INPUT SWITC
18	#4 AUDIO INPUT
19	#3 AUDIO INPUT
20	#2 AUDIO INPUT
21	#1 AUDIO INPUT
22,Z	GROUND





AIM-3 AUDIO & ID MIXER.

TOM W6ORG

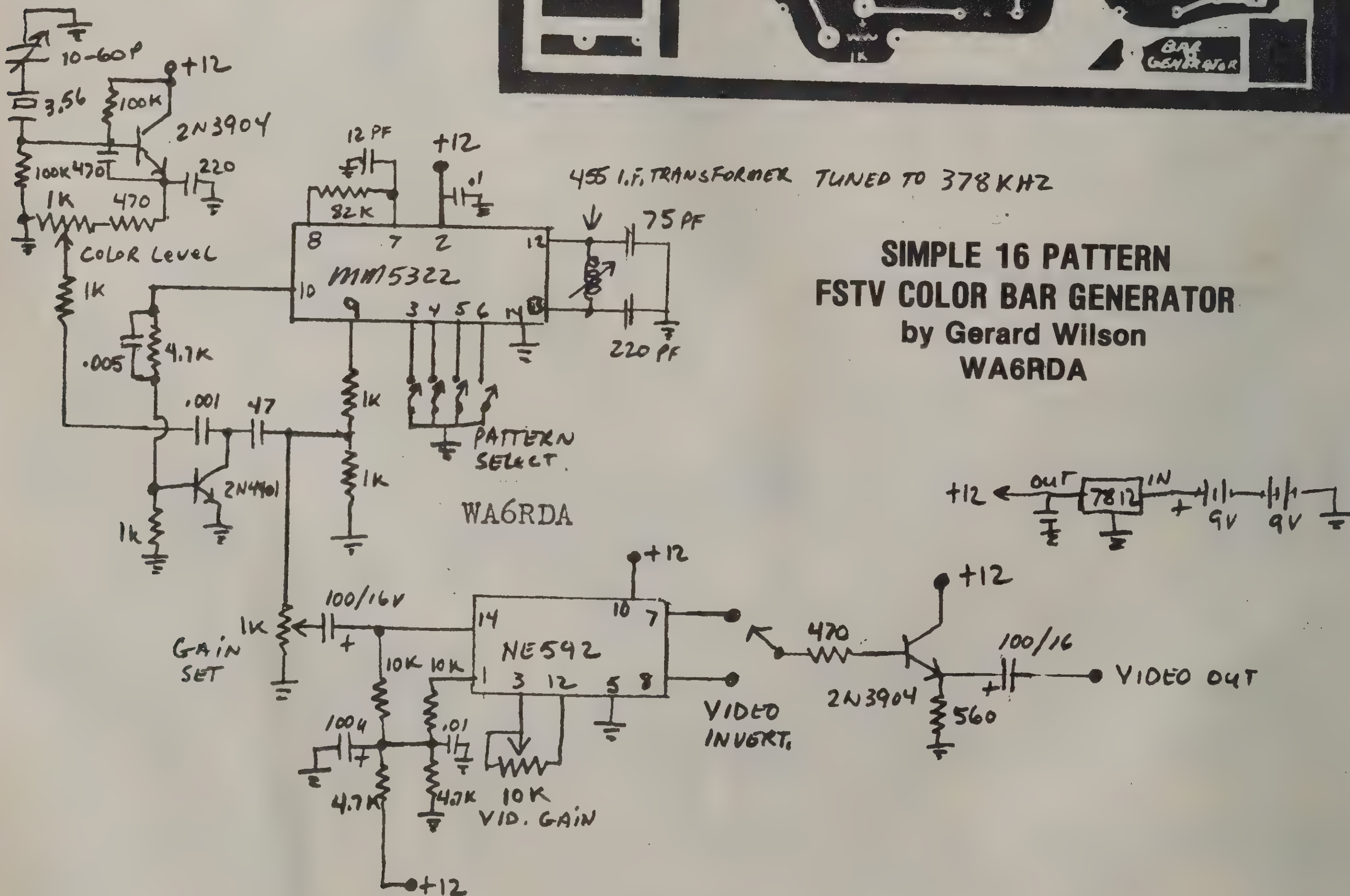
FSTV "HOMEBREW" COLOR BAR GENERATOR

DAZZLE YOUR FRIENDS WITH SIXTEEN PATTERNS!

by Gerrard Wilson WA6RDA
P.O. Box 241
Glen Ellen, California

"Gerard took some time out of his A5 TVRO column duties to give us this economical accessory for ATV. Gerard is our regular "SATV column contributing editor-QCD"

Here is a handy tool to have around the ATV shack. This generator will do all the necessary functions needed for tune-ups. The MM5322 is NATIONAL, available from JAMECO ELECTRONICS, among others, and the NE592 video amp is SIGNETICS, also available from JAMECO. Color burst crystal is Radio Shack, and the 455 Khz I.F. coil is removed from a portable AM radio. This was a TOKO RMC-2A7287, but other coils seemed to work as well. Measure the frequency at pin 12 with freq. counter, and set coil to 378Khz. The pattern select lines may be substituted with a 16 position BCD switch. Gain set control is adjusted so video output does not exceed 2v p-p when the 10k video pot is fully open. The 10k pot is panel mounted and user adjusted to the desired output level. Video invert switch may be hardwired to eliminate the cost of the switch. Color circuitry may be eliminated, if B&W is satisfactory. I mounted circuit with 2 nine volt batteries into a small plastic case for portable use.



SIMPLE 16 PATTERN FSTV COLOR BAR GENERATOR by Gerard Wilson WA6RDA

TVG-23 2300 MHZ ATV TEST GEN

The TVG-23 ATV test generator is a simple video modulated free running stripline oscillator to enable tuning up downconverters or as a QRP 2375 mHz atv transmitter. Power requirement is 11 to 18 vdc at 15 ma. Any standard video source from TV cameras, VCRs, colorbar and pattern generators, or even audio as long as it is between .5 and 2 volts peak to peak into the 75 ohm load. The 100 ohm pot adjusts the modulation level.

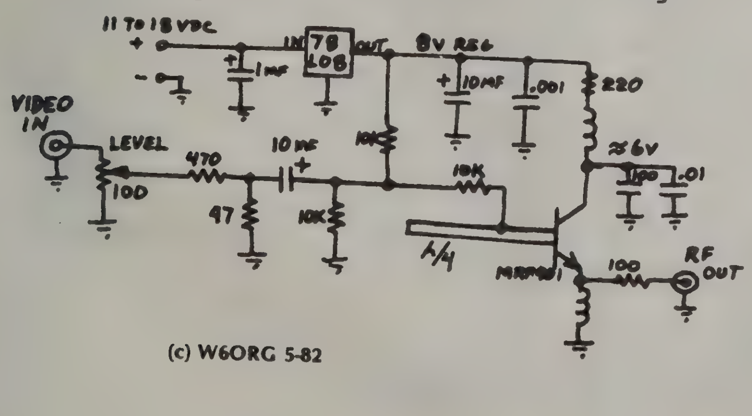
Frequency range is approximately 2100 to 2500 mHz. At microwave frequencies, it takes very little stray capacity to greatly change the frequency. Just the 10K base bias resistor lead has enough capacity to the ground plane to change the frequency as much as 80 mHz by moving it 1/8th of a inch along the base quarter wave stripline. The frequency goes up the closer it is toward the oscillator transistor. To raise the frequency higher, say to 2375 mHz in the ham band, a cut with a Exacto knife can be made at the end of the stripline .1" from the end.

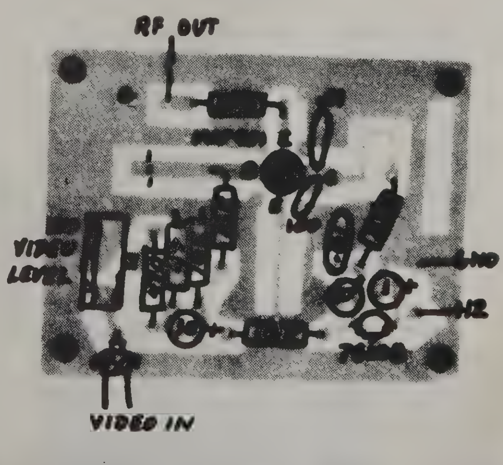
If the cut has been made for the higher frequency but you want to be able to tune lower again and back, solder a small piece of teflon insulated #22 solid wire .3" long to the ground plane next to the end of the base quarter wave line. The closer the wire is to the line, the lower the frequency. The Rf output loading will also have some affect on the operating frequency, so make the adjustments after mounting in any enclosure and with the antenna or 50 ohm load connected. A quarter wave whip is only 1.1" long.

Power output is about one milliwatt which is not enough to radiate more than about 100 ft from the bench without a antenna. This is fine for rough tuning a downconverter front end. For finer adjustments, the TVG-23 should be put in a well shielded box with the power, and video input fed in with feedthru caps. The output can be a chassis connector which can go to a step attenuator to vary and drop the signal level. The power supply can be a small 12vdc unit or battery.

If a antenna is used be sure that the frequency is within the 2300 to 2450 mHz ham band to avoid the possibly of interfering with MDS transmission on 2154 mHz and other services on 2200-2300 mHz. Tune the frequency in on a downconverter of known frequency, a spectrum analyzer, or wave meter to make sure.

When tuning in the video, adjust for best picture. As with any modulated oscillator, there will be some FM with the AM which gives a negative picture on one side of the tuning. With a antenna you will also note some fluctuation as you move around the room due to multipath bounce off metal objects. (c)1982 W6ORG PC EL





CBG-3 COLOR BAR AND PATTERN GEN

The Color Bar & Pattern Gen board outputs 3 color patterns, 12 dot or bar patterns, and a blank raster. These patterns are handy for TV alignment or test video on ATV repeaters. The output can be remotely switched between the patterns and external camera video with the on card video switcher.

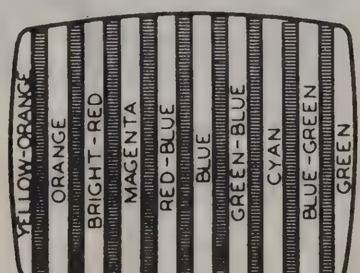
The video out is the standard 1 volt p-p into a resistive 75 ohm load at a transmitter or monitor. Camera video input is also designed for terminating into 75 ohms. To switch between the pattern video and the camera video, a switch is placed between pin 18 and ground. Open is the camera input and closed to ground gives the patterns. The pattern is adjustable using the Video Level pot from Ø to 2 volts. The color amplitude is also adjustable from zero to .7 volts (typical setup is .3 volts of burst on the horizontal backporch with 1 volt of composite video). A variable Ø to .8 v 3.56 mHz is also available at pin 7 for tests and other applications. If your scope does not have a sync separator a 1ØK pullup resistor can be put between pins 1Ø and 12 and used as a external horizontal sync trigger to stabilize the scope pattern.

A momentary push button or open collector pull to ground from a tone decoder is used at pin 19 to step sequentially thru the patterns. In the case of ATV repeaters, a TX+ preset at pin 14 or a pull to ground at pin 2Ø is available that will put on the jumpered favorite pattern. Usually the color rainbow or crosshatch is selected to come on for about one minute after a received video signal is dropped with the video ID superimposed. The jumper pads are BCD numbered but are more easily selected by stepping to the favored pattern, checking for a high or low at the MM5322 pins 3 thru 6, and then soldering in the jumper to the adjacent ground pad of the corresponding line that is low.

A regulated 12 vdc supply at 4Ø ma is required. Make sure the card is plugged in correctly before applying power. The dual 22 pin Radio Shack RS276-1551 connector has the letters and numbers next to the solder pins, and the card has the lettered connections on the component side.

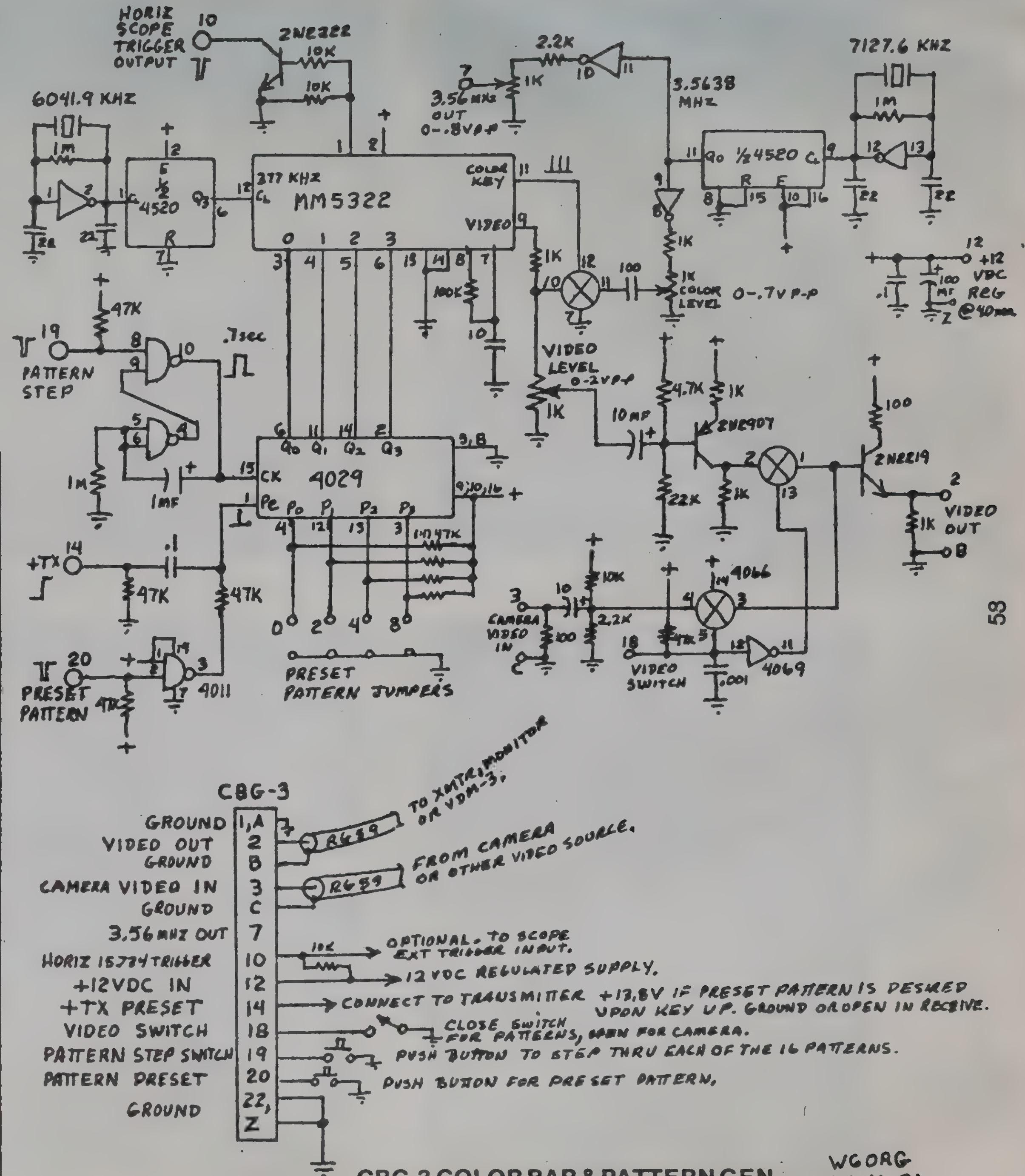
A 7127.6 kHz crystal oscillator is divided by 2 to give the 3.5638 mHz color rainbow frequency. You may wish to discover other color patterns or solid colors by substituting a variable series resonant circuit in place of the crystal. If so note the frequency on a counter at pin 7, multiply by 2 and get a crystal on that frequency. For instance a standard color burst frequency of 3.579545 mHz times 2 (7159.1 kHz) will give a all green raster. The crystals are HC25, .ØØ5%, series resonant, and 15 pf load capacity. The other crystal oscillator determines the sync frequencies. The 452Ø divides it by 16 and the MM5322 does the rest for the horizontal frequency of 15734 Hz.

If no jumpers are applied, the initial pattern upon power up will be the rainbow (1111) since the presets all have pull up resistors. The most popular patterns are the ten color bars (ØØØ1) and the 7x11 crosshatch (Ø1Ø1) for ATV repeaters in the beacon mode. The crosshatch especially seems to show up best in weak signal conditions.



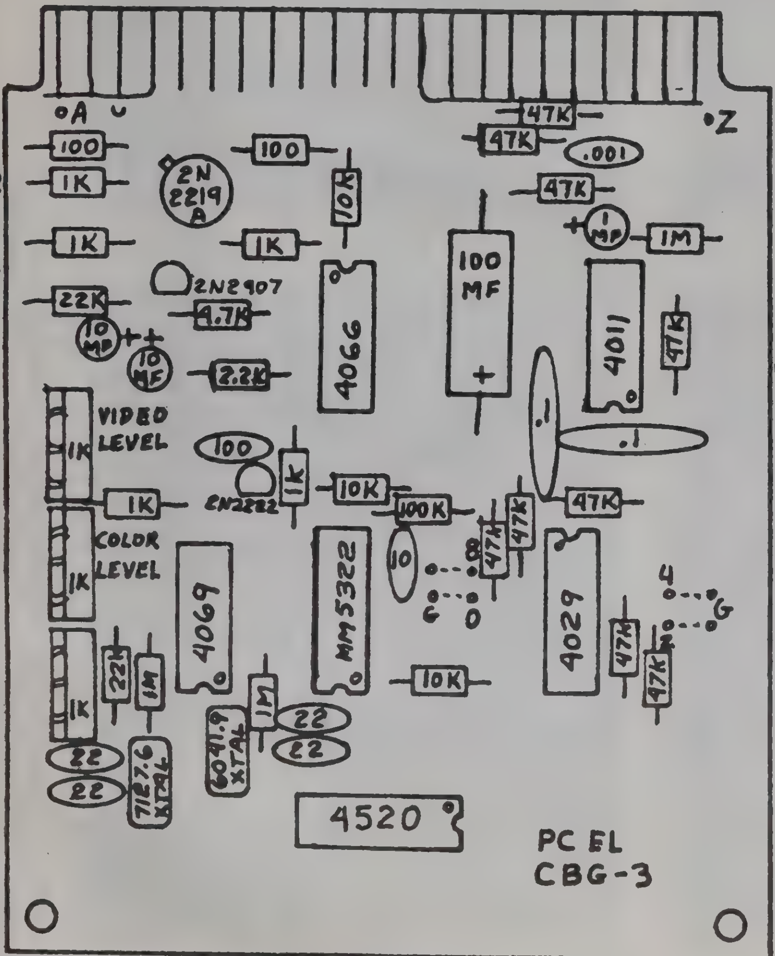
1Ø color bar pattern
(ØØØ1)

1,A	GROUND
2	VIDEO OUT
3	VIDEO IN
7	3.56 OUT
10	HORIZ TRIG. OUT
12,N	+12 VDC IN
14	+TX PRESET
18	VIDEO SELECT
19	PATTERN STEP
20	PATTERN PRESET
22,Z	GROUND

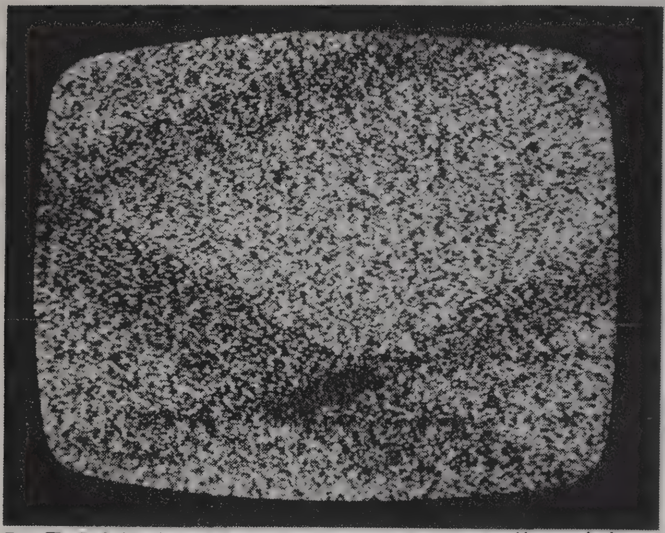


CBG-3 COLOR BAR & PATTERN GEN.

WGORG (c) 11-81



UNITED STATES ATV SOCIETY
AMATEUR RADIO FAST SCAN TELEVISION
VIDEO PICTURE STANDARDS © 1982

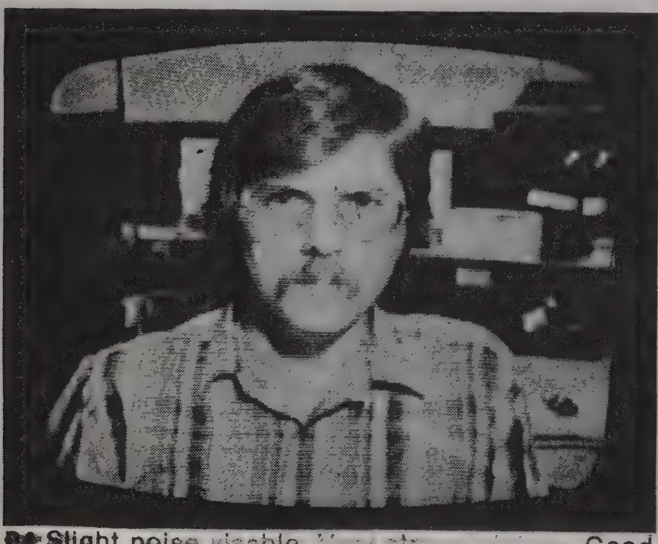


P0 Total Noise Visable. No picture at all, or detectable Video Sync Bars.

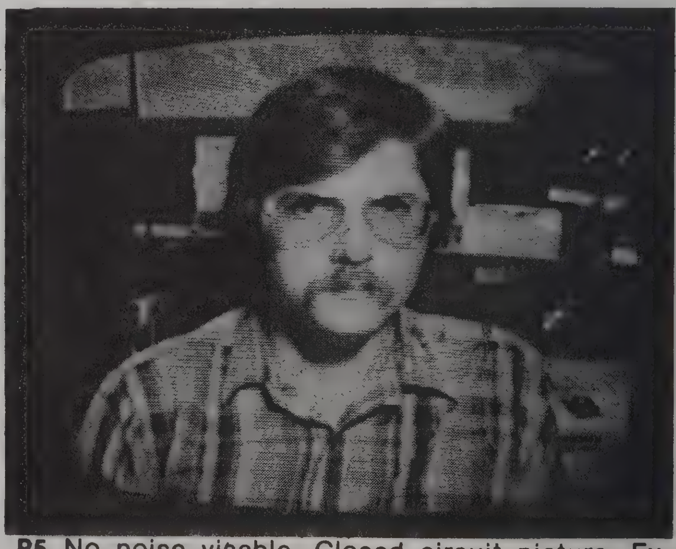
P1 High noise visable. Weak picture.

P2 High noise visable. Fair picture. Fair detail.

P3 Noise Visable. Strong picture. Recognizable detail.



P4 Slight noise visable. Very strong picture. Good detail.



P5 No noise visable. Closed circuit picture. Excellent detail.

Photos by Dave Williams WB0ZJP

FOR A PERMANENT HARDCOPY PRINT OF THIS USATVS FSTV P-CHART (ON WHITE CARDBOARD AND PPD.), SEND $1.50 TO A5

ADAPTING THE COLOR CAMERA FOR MOBILE OPERATION
E.G. "Mike Silvernail", WB4BNJ

The color video cameras now available are a real boon to ATV enthusiasts. It wasn't so long ago that the best that we had available were large, bulky tube type black and white models that were tied to the AC cord.

In the late 60's, 73 Magazine introduced many ATVers to solid state cameras with a construction article on a miniature (in those days) TV camera. Witht he aid and assistance of Harry, K2PTH, Denny, (then) WB2RAB, and I undertook that project. It was several months of frustration from the time we first started winding deflection coils that we managed to see a slight flicker of light on the screen when we held a match in front of the lens.

Today, my Panasonic PK-801 color camera is smaller, has a motorized 6 to 1 zoom lens, built-in 1" viewfinder and microphone, and uses less power. Besides that, it makes excellent color video in less light than that early B/W camera required.

For mobile or portable operation, I use a small box that interfaces the camera to the SE-1a transceiver. Since it outputs with standard video and audio, the interface box should adapt to other ATV transceivers suitable for DC operation.

The box provides the following:

- Standard video output, 1 volt p-p.
- Low-impedence audio with adjustable level.
- Push-to-look capability using the pause trigger on the camera.
- Regulated 12vdc to the camera to protect it from surges and spikes.

Most color cameras have a multiple conductor cable which is terminated in a 10 pin connector. Besides common ground, the connector inputs DC voltage to the camera and outputs video, sound and pause control. It is designed to connect directly to mating connectors on portable video cassette recorders. For AC operation, a small power supply usually is offered which accept the 10 pin connector. Fig. 1 shows the pin-out for the 10 pin camera connector found on most cameras used with VHS type video cassette recorders such as Panasonic, RCA, Sylvania, etc.

The circuit for the interface box is shown in Fig. 2.

The 10 pin female connectors can usually be obtained thru

shops that service the video cassette recorders.

VHS cassettee recorders that I have worked with are paused when the remote/pause line is grounded. It is high for play. The opposite is needed for the SE-1a mic transmit circuit. Q1 inverts the camera trigger button so that the SE-1a will transmit when the camera indicates record mode. The audio and transmit lines connect directly to the mic plug.

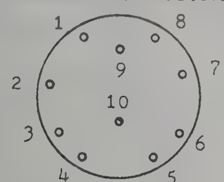
Audio level is controlled by the 1K potentiometer. Normal operating level can be marked, but the control allows for varying the level for different conditions.

The inductors and bypass capacitors on the lines going to the camera are there to discourage any RF that may want to feed back thru those lines. The inductors are 10 turns of 24 enameled wire close wound on the shank of a ⅜" drill.

The color cameras have an internal voltage regulator for stable operation. The one in my Panasonic model is for 9 volts. The 12 volt regulator in the interface box regulates the input voltage and stops any voltage spikes that may be in the automobile electrical system. My camera draws about 625 ma. at 12 vdc, so the T0220 cased LM340T12 was selected for ease in mounting and current capacity. Even thought the regulator is fixed at 12 volts, the input can vary between 11.5 vdc to 15.5 vdc and still provide stable performance from the camera. This is due to the internal regulator in the camera. Check the current requirements of your camera. If it exceeds the 1 amp capacity of the LM340T12, select a regulator with a higher current rating.

The price of color cameras has dropped in the past several years, with some being advertised around the $500 figure. These still offer electronic viewfinder and zoom lens. Some excellent used color cameras are starting to show up at the hamfests at even lower prices. With the interface box, these cameras can be taken mobile/portable to add another dimension to your ATV activity.

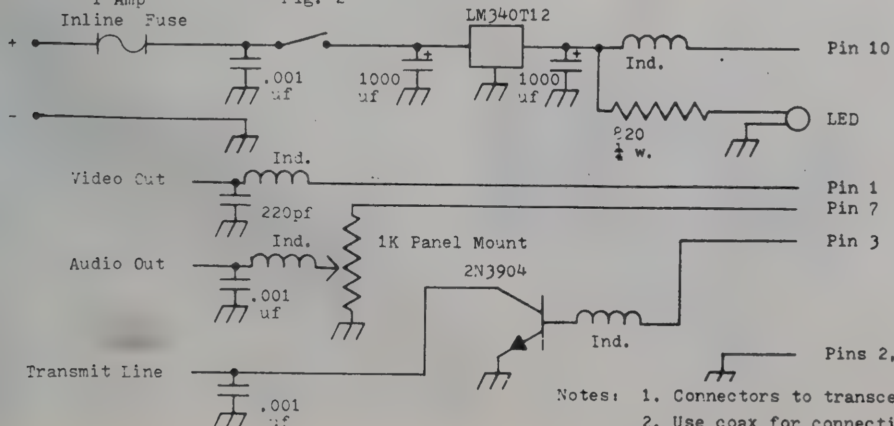
Fig. 1



1. Video Out
2. Ground
3. Camera Remote
4. Reset In
5. Standby Out
6. Trigger (Play/Record)
7. Audio Out
8. Ground
9. Ground
10. +12vdc Input

*Silvernail Electronics
14061 111 Terrace North
Largo, Florida, 33540

Fig. 2



Notes:
1. Connectors to transceiver can be BNC, RCA, etc.
2. Use coax for connections to/from interface box.
3. Capacitors should be 16vdc or higher.
4. Inductors are 10 turns #24 enameled wire closewound on 3/8" drill.

"POPULAR COLOR CAMERAS THAT WORK FOR ATV, SSTV AND VCR RECORDINGS"

PANASONIC [illegible]
QUASAR VK730
PANASONIC WV3320
QUASAR VK720
QUASAR VK725
PANASONIC PK600
JVC GX66
JVC GX77
RCA CC004
SHARP QC35
TOSHIBA IK1650

A5 LOOKS AT 24 POPULAR COLOR VIDEO CAMERAS!

SPECIFICATIONS IN CHOOSING THE RIGHT CAMERA FOR FSTV/SSTV/VCR MODES

MAKE/ MODEL	ZOOM POWER	FOCAL LENGTH (MM)	VIEW-FINDER	HORIZ. RESO-LUTION	SIGNAL/ NOISE RATIO	MIN. ILLUM. (FOOT CAND.)	WEIGHT (LBS.)	FEATURES
AKAI								
VC-X1	3x	15-45	TTL	240	45	10	N/A	N/A
HITACHI								
VK-C750	2.8x	13.5-37.8	OPT.	240	45	10	4.0	A,E
JVC								
GX33	3x	15-45	TTL	250	45	10	3.1	A,F,G
GX66	6x	12.5-75	TTL	250	45	10	3.3	A,F,G,J
GX77	5x	13-65	TTL	270	45	10	3.7	A,B,D,H,I,J
G71USJ	6x	17-102	ELEC.	230	40	10	8.1	A,C
MAGNAVOX								
8244	5x	13-65	TTL	270	45	10	3.7	A,B,D,H,I,J
PANASONIC								
PK400	—	25	OPT.	240	43	10	4.4	C,E,F,G
PK500	4x	12.5-50	TTL	240	43	10	5.3	A,C,E,F,G
PK600	6x	12.5-75	ELEC.	240	43	10	6.4	A,C,E,F,G,I
WV3200	6x	11.5-70	ELEC.	240	43	10	6.6	A,C,E,H,I,J,K,M
WV3320	6x	17-102	ELEC.	250	45	15	5.7	A,L
WV3800	6x	17-102	ELEC.	260	47	15	10.8	A,D,H
QUASAR								
VK705	—	25	OPT.	240	43	10	4.4	E,F,G
VK715	4x	12.5-50	TTL	240	43	10	5.3	A,E,F,G
VK720	6x	12.5-75	ELEC.	240	43	10	6.4	A,E,F,G,I
VK725	6x	12.5-75	ELEC.	240	43	10	4.6	A,C,F,I
VK730	6x	12.5-75	ELEC.	240	43	10	4.6	A,C,F,I
RCA								
CC003	4x	14-56	TTL	240	43	10	4.5	A,C,E,J,M
CC004	6x	11.5-70	ELEC.	240	43	10	6.6	A,C,E,H,I,J,M
SHARP								
QC-35	6x	17.5-105	ELEC.	230	44	10	7.8	A,C,E
SONY								
HVC1000	3x	14-42	TTL	300	45	10	4.75	A,F,H,K,M
TOSHIBA								
IK1610	—	25	OPT.	250	46	10	4.8	B,C,F,G
IK1650	6x	12.5-75	ELEC.	250	46	10	7.5	A,C,F,G

POPULAR 1981/1982 MODELS AVAILABLE IN THE "USED" MARKETPLACE AT REDUCED VALUES

LEGEND:

- A Auto Iris
- B Optional Electronic Viewfinder
- C A/C Adapter included
- D Auto White Balance Control
- E White Balance Control w/Meter
- F Color Temperature Compensation Switch
- G Removable Hand Grip
- H Rotating Hand Grip
- I Power Zoom Lens
- J Macro Zoom Lens
- K Carry Case Included
- L Separate Color Control Unit
- M Built-in Indoor/Outdoor Filter

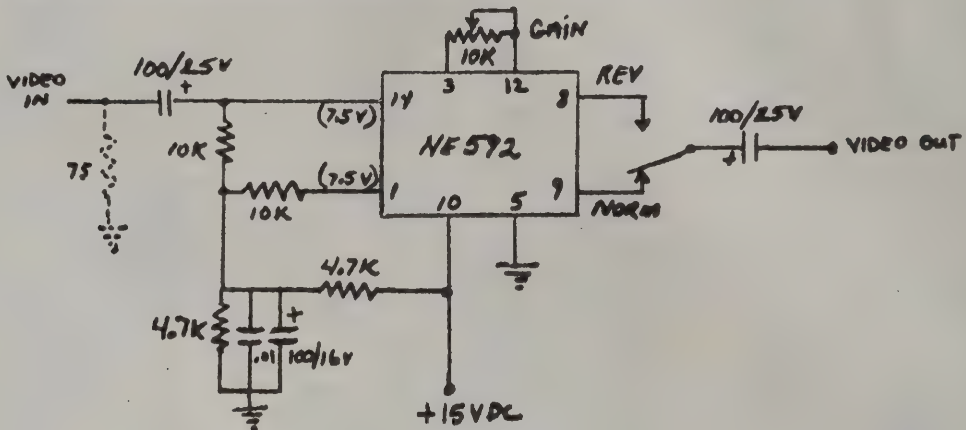
VIDEO SWITCHERS & AMPLIFIERS
By G. Wilson, WA6RDA

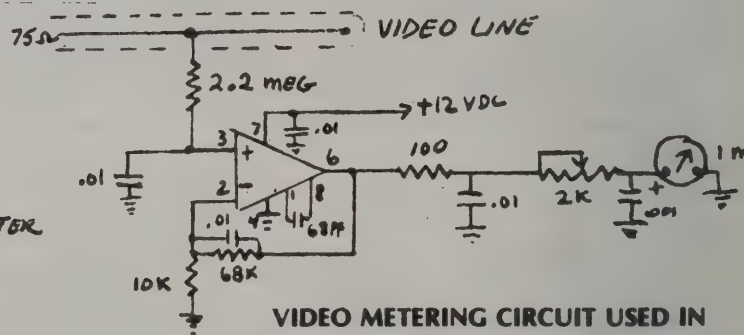
When working with video, you must remember that it is, in fact, a form of RF. Therefore it must be shielded and terminated with the proper load resistance in much the same manner as a transmitter. Since most video is designed around 75 ohms, RG-59 and PL-259 hardware have become the chosen standard to the industry.

There is bound to be times when more than one camera or video source needs to be switched into your ATV transmitter. The simplest form of a video switch, is to use a RF coax antenna switch box. This is handy when switching from a VTR to camera, but it can have its drawbacks. If you have a monitor on the line, the system needs the 75 ohm termination, and if you are switching the line open, the monitor will not be properly terminated and the picture will probably tear. Also, if the video levels are not the same, you will have to continually re-adjust the video gain on the rig.

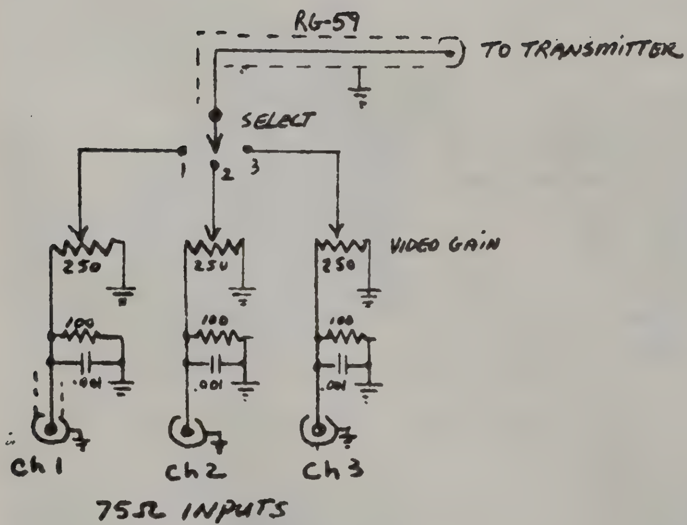
The video switcher shown is a simple solution to all of the above problems. When constructing, remember to keep leads short, and shield in a metal box if possible.

The following circuit will both amplify the video and also allow you to switch polarities. Sometimes when tapping into certain TV sets, the video may be of the reverse polarity. This circuit will allow instant reversal, and also allow you to set the proper gain level.



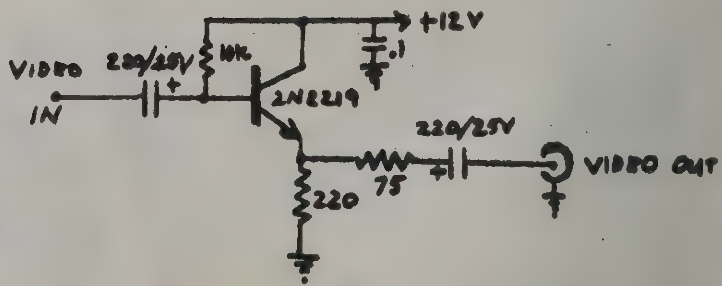


VIDEO METERING CIRCUIT USED IN SYSTEM ELECTRONICS UNIT. RCA CA3130, no substitutes!



VIDEO POLARITY SWITCHER AND AMPLIFIER SIMPLE VIDEO AMPLIFIER

METERING VIDEO GAIN. A relative indication of gain can be used achieved with the following circuit. This is especially useful when operating portable, where a monitor is not available.



A simple video amplifier with in-phase output can be added to help boost low gain.
F1633 F1632

VIDEO TAPE RECORDERS

One of the best sources of video to transmit is recorded pictures. A collection of ATV contacts can be edited down to a short tape showing the gang. Tapes can be exchanged with other atv clubs so each area can see how the other half hams it up. DX ATV contacts and other special events pertaining to our hobby can be recalled for later showing. Vacation trips and home movies make good viewing and ok for late nighters from time to time an adult movie has been put on the air, this practice is not encouraged by most. Metrovision has put together a very funny tape of old silent comedy flicks mixed with their own caption explaining metrovision atv group. School and church plays are neat to see over atv. Some groups make up complete shows to be shown on ATV. Video tape will expand your program material outside your shack and is only limited by your imagination and resources on hand.

Mike Stone WB0QCD of A5 ATV Magazine has a growing library of tapes representing various ATV groups and encourages the exchange of tapes for all ATV groups to "see" each other. A list of these tapes is available with duplication in VHS format available for the cost of a videocassette and mailing fee. VCRs are available in two common consumer types VHS and Beta formats both have similar picture quality. Beta machines are generally cheaper but have slightly shorter maximum recording times than the VHS system. VHS is used more in most areas but some geographical areas have high beta to VHS in use. A good example o this is San Diego ATVers have almost all Beta format in use and Los Angeles ATVers have almost all VHS format in use. The main thing to consider in selecting a format to buy is to find which format your ATV as well as other friends use so you can swap tapes. Another thing to look for is features you intend to use, both VHS and Beta formats have some machines which have a scan or search function that makes finding a desired scene easier and faster to locate also some machines have improved editing capabilities that should prove very useful for ATVers.

The VHS formats....The VHS system has three speeds, when using a T-120 Cassette. The SP mode gives 2 hours, the LP gives 4 hours and the EP also known as SLP gives 6 hours.

Audio is recorded in the same manor as the audio tape machines so no need to go in detail here. Video on the other hand can't be recorded directly as is on an audio recorder. This is because of the many octives that must be recorded. Video frequencies run from 60 HZ to 4 MHZ a video head cannot be designed to give a flat response over this range so a new way of recording was developed to approach a flat response. This system takes the video and frequency modualtes a 4 MHz carrier.

The video head can now be designed for 4 MHz and the head is now used for a few octives, the sync pulse is at 3.4 MHz and white peaks are at 4.4. MHz. color recording. Due to the wow and flutter of video machines, the color is not recorded along with the Y signal. The reason is that the chroma frequency and phase would shift around and produce a poor color shift at this frequency is many times less. High Density Recording.....Industrial and educational helical Scan recorders the track is 100 microns VHS recorders have reduced the track to 30 microns this gives 3 times the recording time for a given amount of tape. In the SP mode there is some guard band (28 microns worth) in the LP mode there is no guard band. An overlap of 1 micron exist and in the SLP mode a 10.7 micron overlap is present. By now you might wonder why no crosstalk occurs and the way this is prevented is to use azimuth recording. Azimuth is the left and right tilt of a head. In the VHS system a +8 -6 degree azimuth is used. The video head A will not pick up track B since it is not in correct Azimut alignment with track B but will produce an output from track A. For more details on this format it is suggested to read a service manuals principle of operation section as a general operation is discussed here also the operation changes slightly with special effects VCRs.

THE BETA FORMULA

Currently the beta format has two speeds, beta 2 and beta 3 old beta machines used beta but this speed is no longer used to any great extent. Beta 2 is two hours and beta 3 is three hours using a L-500 tape. Up to 5 hours is available using a L-830 tape and the beta 3 speed. Audio is recorded in the conventional way as in a audio recorder. Video is recorded similar to that in the VHS format as discussed earlier. Beta uses the frequency modualtion of a carrier in the 4.2 MHz range. The sync tips are at 3.6 MHz and white peaks at 4.8 MHz. The chroma is down converted to 688 KHz to be directly recorded.

Helical scanning is used to lay the reacks down on tape as is the case for the VHS format. Azimuth recording is also used in the beta format to prevent crosstalk. The azimuth tilt is +8 -8 degrees. More details are available about this format in betamax service manual under principle of operation section.

PERIODIC MAINTENANCE

Cleaning of video heads, use a piece of chamois cloth saterated with isopropyl alcohol and with the power off press lightly on the drum and turn top of drum with your other hand to remove the dirt. Never scrub a video drum vertically as the video heads will break and heads cost over 100 dollars to replace. Check the rest of the drum to confirm tha it is clean. Next clean the audio, erase and control head surfaces. Clean all tape guides and post that come in contact with the tape also the loading post should be cleaned. If the machine is dusty inside blow the dust out first with compressed air, the fan area can get very dusty, before head cleaning. Cleaning should be done every 500 hours of use or 6 months which ever comes first.

Video head should last 1000 hours of use but most make it to 2000 hours if kept clean and junky tape kept out of the machine. Stay away from head cleaner tapes that don't use the chamois cloth and fluid cleaning method. The others use an abrasive tape to sand off the dirt. Belts and Idler wheels need cleaning at the same time as the heads. Capstan and other square belts should be replaced every 1000 hours or every two years which ever comes first as they can break after that time period. Capston bearing, roller loading gears and takeup and supply hub bearings need oiling every 1000 hours. Use a drop of 20 sae or sewing machine oil, no spray oil also to much oil can be worse than no oil.

Every two years the machine should be taken to a reputable-repair shop for inspection and adjustment as it would be impractical to do this without the sophisticated equipment needed to properly do the job. If you decide not to do the periodic maintenance yourself then the machine should be taken to the shop for such work. A shop cleaning and lube job can cost 80 dollars or so. A service manual is helpful in giving detail on maintenance.

By Mike Collis, WA6SVT
Costa Mesa, CA

CHAPTER 10
THE ATV ANTENNA

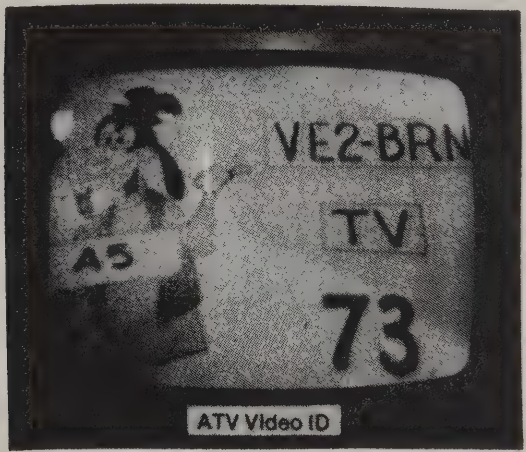
The antenna at VHF-UHF frequencies becomes the most important part of the overall system. One reason is because of the surrounding objects, buildings, trees absorb more and more of the radiated power the higher we go in frequency. At 432 Mhz, this effect becomes very pronounced, so the higher you can mount the antenna, the better the results will be, due to the radiation clearing the surrounding buildings, trees, etc. Another reason is because we always use the same antenna for both transmitting and receiving, so the better we make the antenna for both transmitting and receiving, so the better we make the antenna the better the results will be for both transmitting and receiving.

The antenna at VHF-UHF frequencies is by far the cheapest and most efficient way to increase the effectiveness of our station. At low frequencies, the physical size of the antenna is such that most hams increase power of the transmitter to improve their station effectiveness, but a VHF-UHF increasing power of the transmitter is expensive and hard to do at present state of the art. Increasing the amount of antenna will have the same result as increasing the power of the transmitter and since the antenna at 432 MHz is small physically it is by far the best way to increase your station's effectiveness.

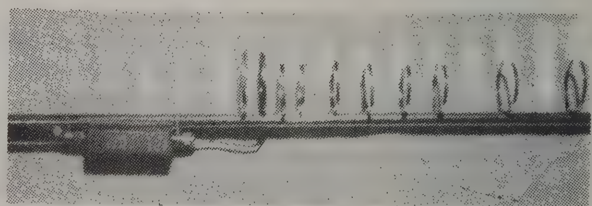
Generally speaking, doubling your transmitted power **output** will result in a 3 DB signal increase. Doubling the amount of antenna will also result in a 3 DB signal increase with the added benefit of a 3 DB increase of the received signal. Example:

50 watts into (1) dipole ant = 50 watts radiated
100 watts into (1) dipole ant = 100 watts radiated
50 watts into (1) dipole ant = 50 watts radiated
50 watts into (2) dipole ant = 100 watts radiated

This example assumes a perfect, no loss, feed to the antenna which of course is not practical, but does show than an additional piece of aluminum tubing and a piece of wire phasing line will give the same results as increasing your transmitter output by two. Of course there is no comparison in cost and work involved. So the antenna and feed line at VHF-UHF system. Unfortunately there are very few good antennas on the market, so we have to homebrew the better antennas if we are to use them. There is no more intriging and rewarding work to do than building your own antenna, and when a station says your 10 watter sounds like a KW, you can rightfully take pride, because you built it yourself.

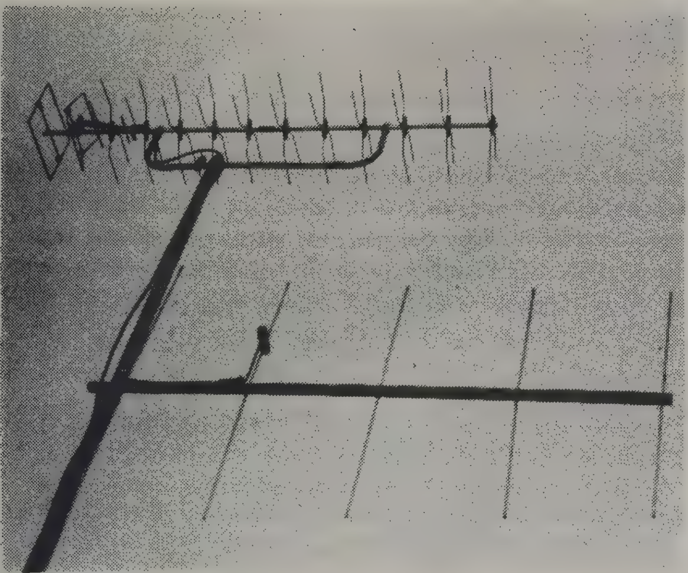


1296-LY LOOP YAGIS ANTENNA

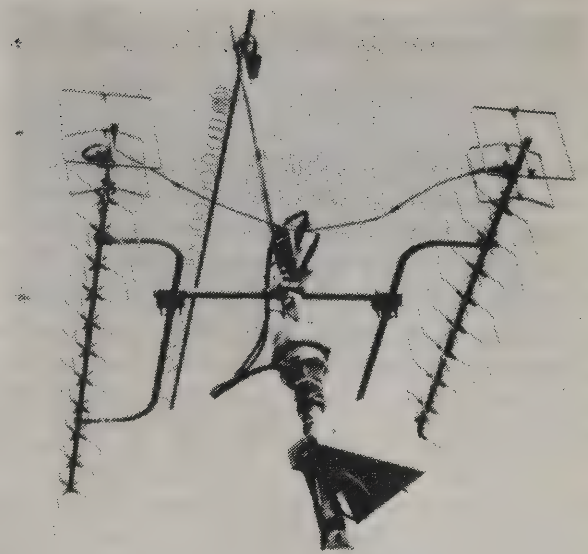


One of the most popular and versatile UHF antennas for Amateur Television work with high-gain is the 1296-LY Loop Yagi. The antenna is very broadbanded covering a frequency range of 1250-1340 Mhz. with rated gain equal to a 4 foot diameter dish antenna system at 20 db over isotropic claimed by the manufacturer. The beamwidth is about 20 degrees on E plane & 18 degrees of H plane and uses a type N feeding connector and 50 ohm impedance matching. The 92 inch boom length is adequate for lightweight mounting as shown on the front cover of W6ORG's antenna system. The individual loop diameter is 3 inches nominal with the overall antenna weight less than 1-1/2 pounds. Rated wind survival is 80 mph minimum. The antenna is horizontally polarized when the loops are mounted above or below the beam's boom masting. This antenna is ideal for ATV links, video-duplexing when tied in with 1296 varactor triplers and repeater remote receiving. The 1296-LY Loop Yagis can be "stacked as detailed in the drawings below.

The 1296-LY Loop Yagis antenna can be purchased from several advertised ATV dealers and is U.S. Distributed by Spectrum International of Concord, Massachusetts. Suggested retail is $64.70.



KAØBVT Iowa ATV/2 meter System



W6ORG ATV SYSTEM

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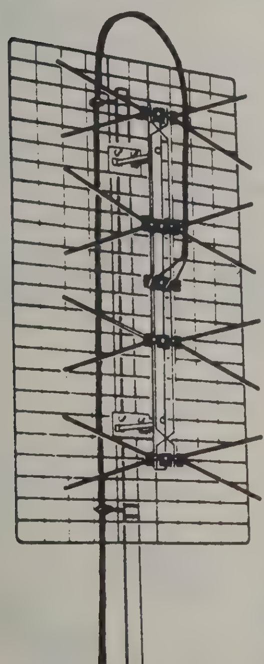
WINEGARD INTERCEPTOR®

Models KU-420, KT-420

Point toward stations



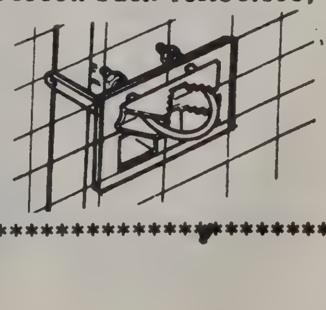
4-Bay Bowtie

One of the key ingredients in working ATV DX is knowing when the band is "open". A number of methods are popularly used including monitoring the UHF frequencies & or even watching higher VHF frequencies propagation patterns. One sure way to know the "band is up" is by looking for UHF commercial TV stations. Since 439 Mhz. antenna arrays are usually well below many UHF channels, it is very handy to have a separate UHF-TV antenna preferably mounted on a rotatable mast to turn 360 degrees covering all areas. (Also gives a nice addition of TV channels). Some areas are VHF commercially served with no UHF broadcasting stations for hundreds of miles and seperateUHF TV antennas are "hard" to find. This antenna pops up occasionally at "hamfests" when areas are changed over to cable-TV and generally runs $20-25.00. It can be easily mounted on existing masting and takes up little room for non-interference (37" X 20"). Other designs can be homebrewed and designed to known station UHF frequencies. If the pictures are P3-P5 and especially if the audio subcarrier is coming through, the ATV band is most likely ripe for the picking!

Specifications: 8 inch by 8 inch bent (8") elements-2 to a section-total of eight sections, 300 ohm feed, 24 inches from top center V to bottom center V, 1 1/4 inch separated multi-joining feed run connection (wire), 5 1/4 inch distance from reflector screen, 10-2 inch X 36-1 inch vertical screen back reflectors.

WINEGARD
TELEVISION SYSTEMS
WINEGARD COMPANY • 3000 KIRKWOOD STREET • BURLINGTON, IOWA 52601

For channels 14-82 UHF



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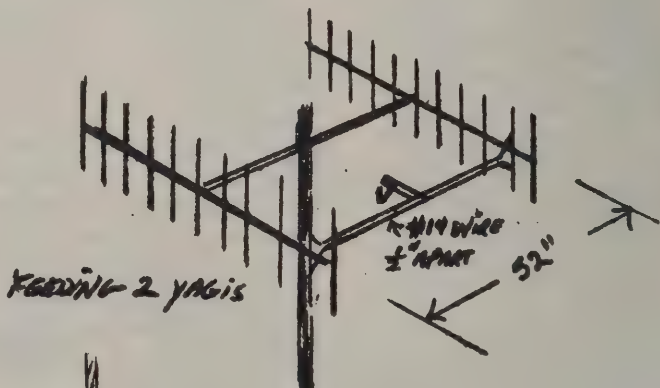
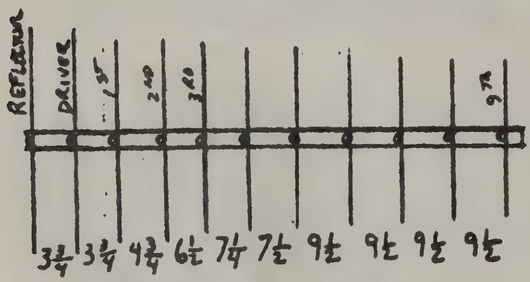
USING YAGIS ANTENNAS
FOR AMATEUR TELEVISION
BY WA6RDA

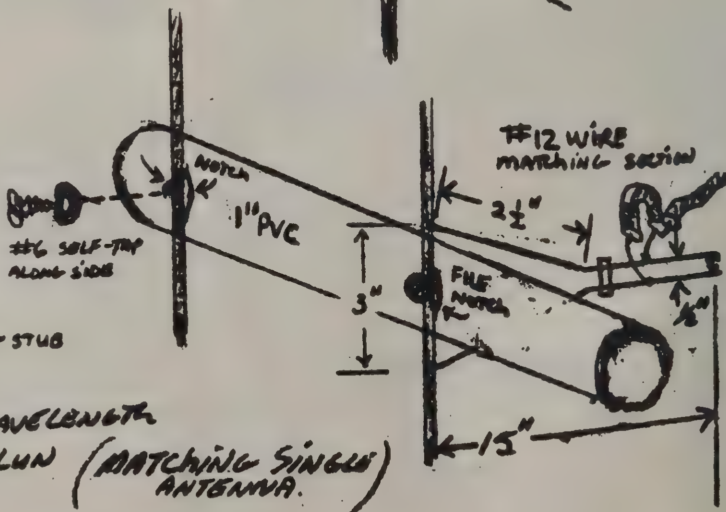
High gain antennas are almost a necessity for Amateur Television operation. The physical size is small enough at 432 Mhz. to enable a multiple element array to stem from a small inexpensive rotor. One of the possible drawbacks of using Yagis antennas for ATV is that the bandwidth might be too narrow thereby "chopping-off" the audio and color subcarrier & possibly the sync tips that ride up to 4.5 Mhz. above the video carrier signal. This is why some stations with similar equipment "in the shack" obtain different results on the air. The audio sub-carrier is super-imposed nearly 30 db down from the main video carrier and the Yagis antenna design could very well roll-off several db 4-5 Mhz. above resonence which cuts down the distance workable for DX'ing. One method to overcome the narrow bandwidth problem is to stagger tune some of the antennas within the array achieving an overall flatness. Color ATV requires a 3.58 Mhz. "colorburst" signal accompanying the main carrier.

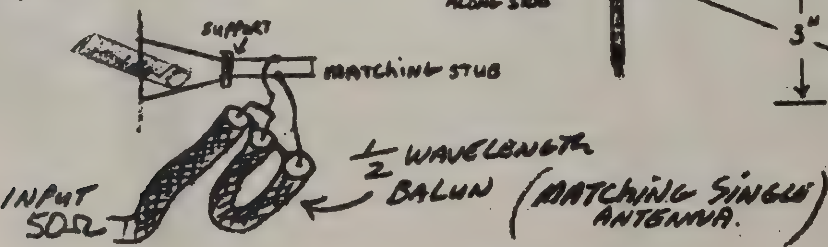
Most ATV in western states and elsewhere is done vertically polarized. Horizontally polarzed ATV antennas (popular in midwestern and some eastern states) can be accomplished by simply turning the array 90 degrees upon mounting. Vertical operation is popular for repeater and mobile operation. Stacking yagis type antennas is quite simple and provides another 3 db of gain. Constructing an 11 element Yagi (designed for 434 Mhz.) can be started by using 1 inch sked 40 PVC pipe. The elements, which are laid into a "notch" filed by a rat-tailed file, are constructed out of 1/8 inch brass rod. The elements are secured by self-tapping set screws with a flat washer alongside. Remember when attaching a cross boom to find the balance point and then cut out a section equal to the T and glue in a threaded T that will accept 1/2 inch water pipe.

Reflector	13 and 1/4 inches
Driver	13 inches
Director	12 inches
#2	11 and 7/8 inches
#3	11 and 3/4 inches
#4	11 and 5/8 inches
#5	11 and 1/2 inches
#6	11 and 3/8 inches
#7	11 and 1/4 inches
#8	11 and 1/8 inches
#9	11 inches









J Beam MBM48/70cm Antenna

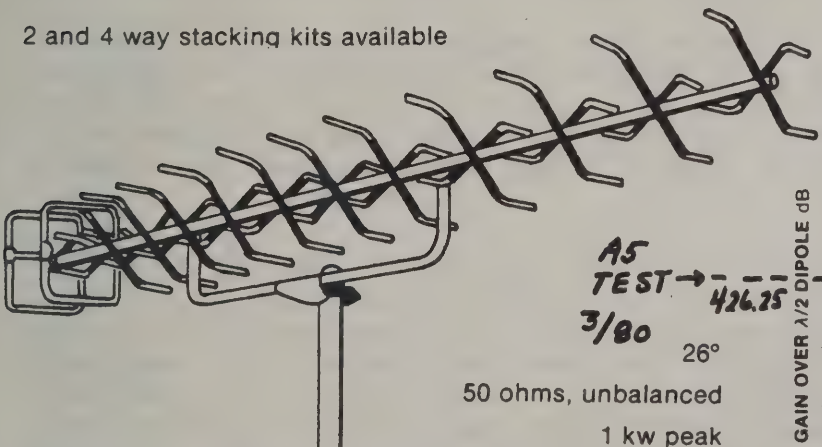
420-450 MHz

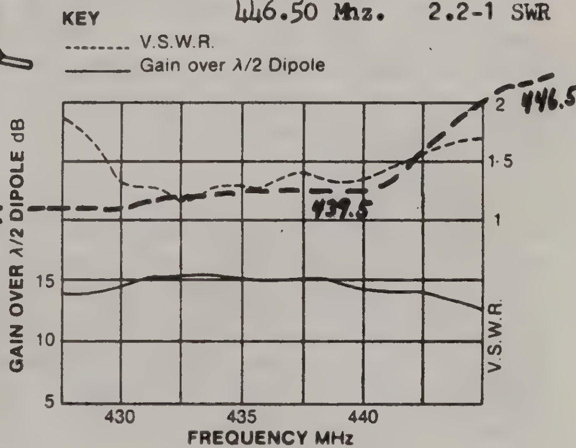
MBM 48 ELEMENT 70 CM UHF "J-BEAM" ATV ANTENNA   15.7 db (dipole reference)

Manufactured in England, imported to the states, the "J-Beam" UHF antenna is but one of several systems designed for wideband 70 cm. use. Upon recommendation by Tom W6ORG of PC Electronics, I built a 96 element system--using two antennas with co-phasing (harness available) with 4' 9" spacing (48 inch recommended). After six months of fighting with various types of cables for my feed line (including a run of hardline with flexible RG8U on both ends and connectors that always showed bad VSWR), I decided to use a new piece of quality BELDEN 8214 RG8U type coax. The following results were obtained (using BIRD wattmeter 200-500 Mhz. slug at transmitter). The "J-Beam MBM 48/70 CM" antenna has about a 15-20 degree beamwidth (stacked array) on weak signals. The gain is so great that it becomes a "razor sharp" beam perhaps not desireable by those looking for broadness. Demonstrating almost 20 Mhz. bandwidth under 2-1 SWR-the system is ideal for ATV operation, excellent for 432 SSB activity but too narrow for OSCAR Satellites. The six-foot length of the boom takes up less space than other antennas with nearly the same gain fiqures. (An 88 element model with yet higher gain is available) It must be pointed out that each arm of the crossed elements represents 4 elements and each section of elements must be mounted exactly as pictured. When using phasing harnesses, the direction of the entering feed cable must flow the same direction to both antennas (not specified in instructions). Two antennas should show a very respected 18.7 dbd gain fiqure. My 8 watt video signal modulated is now being seen regularly with P4 quality some 41 miles away at 439.25 Mhz. simplex. The beams can be obtained from Spectrum International or PC Electronics for around $70.00 each. WBØQCD

2 and 4 way stacking kits available

426.25 Mhz.	1.3-1 SWR
439.25 Mhz.	1.4-1 SWR
446.50 Mhz.	2.2-1 SWR





AS TEST → 426.25
3/80

26°

50 ohms, unbalanced

1 kw peak

length-72 in., width-18 in., height-14 in. with mtg. bar
weight-6 lbs., wind load @ 100 mph-38 lbs.

Stacking Data: (maximum distance)

Hor., Boom to Boom	48 ins
Vert, Boom to Boom	48 ins

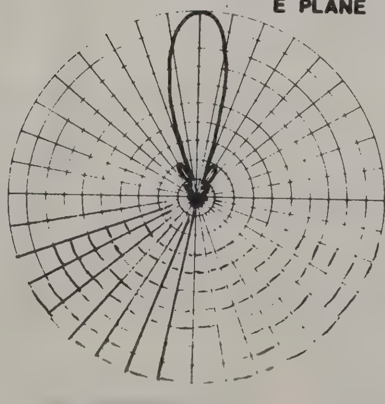
Electrical Data:

Power Rating	1 KW
Coaxial Feed	50 ohms
Balanced Feed	200 ohms

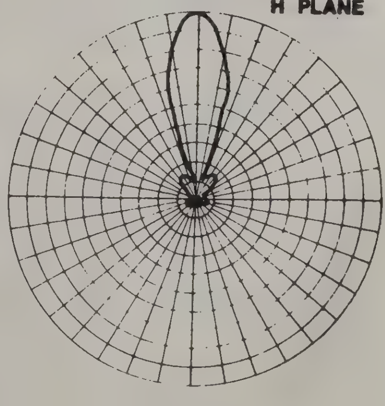
Mechanical Data:

Length	72 ins
Width	18 ins
Height	8 ins
incl. mounting bar	14 ins
Weight	6 lbs
Wind Load (100 mph)	38 lbs

POLAR DIAGRAM
E PLANE



POLAR DIAGRAM
H PLANE



THE OCTOPOLE
(8 DIPOLE HORIZONTALLY POLARIZED TURNSTILE ANTENNA)
COLUMBUS, OHIO ATV REPEATER ANTENNA
by Art Towslee, WA8RMC

Here is, what I believe to be a new twist toward an omni directional horizontally polarized gain antenna.

I started with the classic turnstile - 2 dipoles at right angles to each other in the same plane fed with a 1/4 wave line section. The 1/4 wave section of coax was messy - there must be a better way. I decided to stretch the 1/4 wave section out vertically and mount the dipoles above one another. This worked. Next, I needed gain. (A single turnstile has (-) 3 DB gain because it is 2 dipoles in parallel, each consuming half of the available power fed to them.) Stacking them did produce more. Unity gain resulted. This was still not enough. At least 3 DB gain is desired, but that required 8 individual dipoles. Each dipole has a 70 ohm feed impedance so 70 ohms ÷ 8 = 8.7 ohm feed impedance. This would be difficult to match to a 75 ohm feed line.

To achieve A higher antenna feed impedance, folded dipoles were tried for each element. (A folded dipole impedance is approximately 300 ohms, so 300 ÷ 8 = 37.5 ohms). This would be much easier to match. A preliminary test of the final design showed very promising results. The SWR was very low and the measured gain was 3 to 4 DB over a dipole.

The major design details of the "OCTOPOLE" antenna that resulted are as follows:The bottom 6 1/2" of vertical mast is actually a 1/4 wave 62 ohm matching section to transpose the 37.5 ohm total dipole impedance to a 100 ohm feed impedance. The impedance of the rest of the line up to the top element is also 62 ohms but since the line repeats every 6 1/2" the impedance is unimportant. The 62 ohm line impedance is actually a compromise. A better match could be achieved, but at the expense of non-standard copper pipe sizes. Actually, 100 ohm feed is not too far away from a 75 ohm perfect match and theoretically, could produce a maximum of only 1.2 : 1 SWR. There is also a second reason why I settled for a value of 100 ohms. Later, a second antenna will be constructed and added in parallel with this one producing 1 antenna on top and 1 below with the feed in the <u>center</u> via a coax "T" fitting. With this approach, the theoretical feed impedance of each antenna <u>SHOULD</u> be 150 ohms (150 ÷ 2 = 75 ohms). If the folded dipole is bent out from an oval toward a loop (remember the halo) the dipole feed impedance <u>lowers</u> which will <u>raise</u> the total feed impedance. A 75 ohm match can be achieved in this manner.

The performance of this antenna has only been rough tested. I know that 4 DB over a dipole is reality but the pattern does have 1-2 DB notches as it is rotated about a vertical axis. The horizontal axis has not been tested. I intend to do this in the spring to give me a better idea of the antenna's angle of radiation. I hope to report more concrete performance data in a later article. In the meantime, the antenna is getting an environmental durability test on top of our ATV tower.

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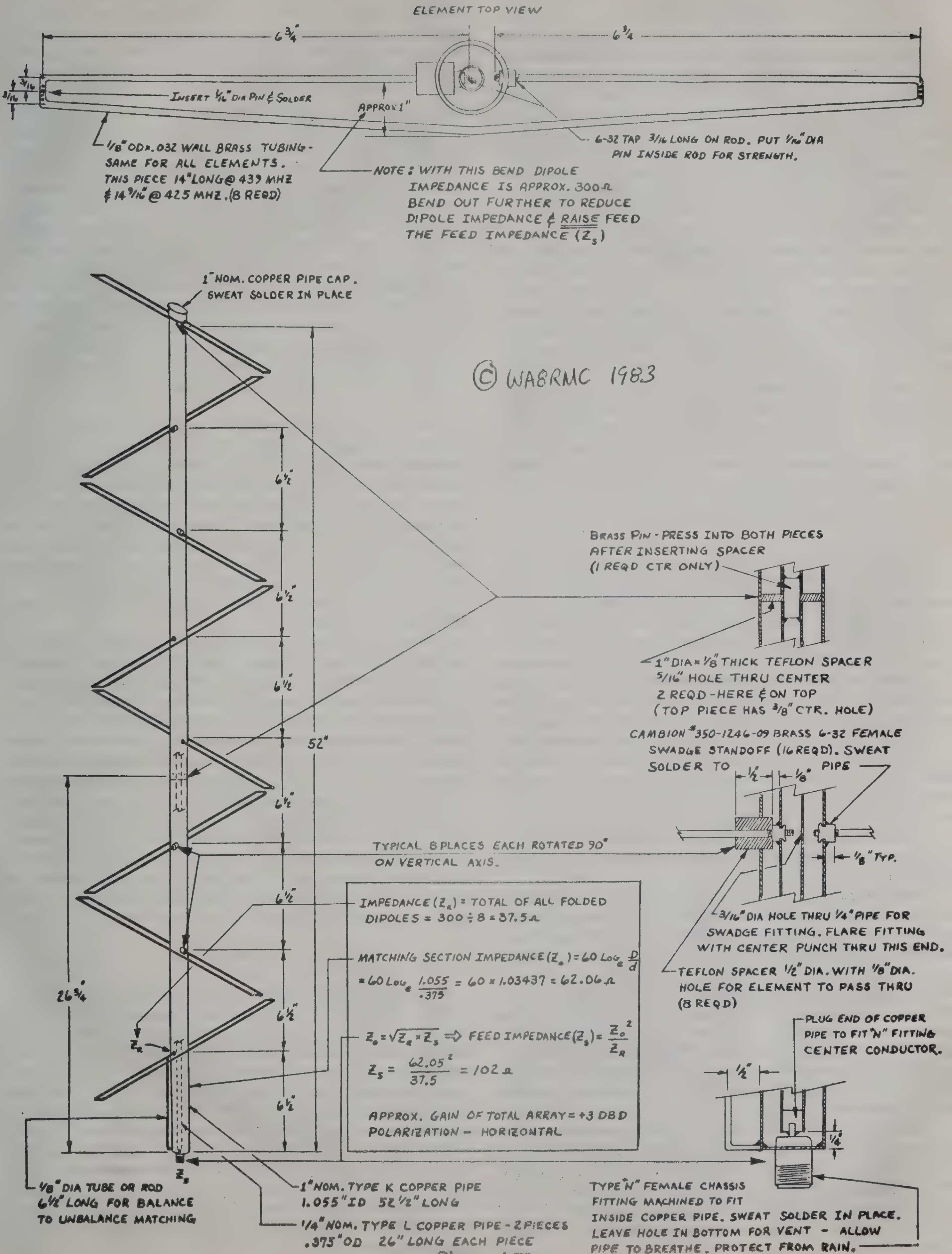
OCTOPOLE DETAILS



CHAPTER 11

ATV REPEATERS
By Tom O'Hara, W6ORG

Putting up a repeater on ATV is much more difficult than FM due to that old demon desense. With FM you can use relatively simple and available high Q cavity filters to keep the transmitter and its sidebands from capturing out the receiver. Bandwidth is only 15 kHz for FM, so that 5 mHz away, the high Q filter attenuation is way down. With ATV you have to have a flat 5 mHz passband and at the same time kill any transmitter energy only 12 mHz away. This is quite a requirement for a filter, but necessary for good color and sound with an inband repeater. Consider that if your repeater receiver has a 1 microvolt sensitivity (-107 dbm), and that your repeater transmitter is running 10 watts (+40 dbm), the total rejection necessary is 147 db!

The minimum basic repeater is presented here by function and fully discussed. You may not want to follow the design exactly depending on what you have available already and how much you can afford. If each part is bought new as described your complete basic repeater system will cost under $2000. The requirements discussed will allow you to better decide what to use or try substituting. Also, by using the functional module approach, later as you see possible improvements and additional features, its much easier to add on without disrupting the whole system.

SYSTEM CONSIDERATIONS

Before you spend a dime on equipment, you might want to consider some alternatives and make some tests. First and most important question is, what will the repeater do for the area that simplex is not doing? Unless you are well off, the dollars and time must be weighed against the expected results. If all the atvers in your area are within a 15 mile radius in a valley or flat terrain, then perhaps simplex with omni antennas would work as well. If all the atvers in your area can work each other but must rotate their beams then you must weigh the cost vs the inconvenience of beam rotation and those outside the antenna pattern main lobe during a roundtable being left out. Repeaters really work well for bringing together groups on each side of terrain obstructions, public service functions such as being able to key up the local weather radar in the tornado belt, club and swap nets, etc., or any operating where there are many who have to watch at the same time.

The second consideration is what frequencies to use. If you put on a inband repeater, there is not enough room in the 420 to 450 mHz band to also have a simplex frequency without the sidebands giving some interferance. As UHF FM gets more popular and summer inversion skip comes in, 439.25 mHz may experience some interferance. The lowesest input frequency if interferance is experienced in 434.0 Remember we need enough separation for the filters. The VUAC (APRIL VHG and UHF Advisory Committee) in 1979 suggested 421.25 mHz and with the Spectrum International PSF-421-ATV interdigital filter to keep the LSB down 50 db, this frequency has worked well for the repeater output.

The best thing to do is to first contact other band users in the area, frequency coordinating committee, or ARRL SCM to find out what frequencies are in use. Once the crystal is bought, nobody wants to change. So a little checking will prevent a hassle later, plus let others know so they don't plop down on your subcarrier frequency, or you might even get them on atv.

Crossband repeaters have two distinct advantages. First they allow the users to see their own video coming back without any special filtering at their stations. Usually 5 to 10 ft. vertical separation between the two antennas is enough. This allows adjusting their own equipment and pictures without depending on someone else talking it in. If your group is into computers or RTTY you can see the computer output come up as you push the keys and know how its coming through. Secondly, it frees up space for a simplex frequency so that more than one person at a time in your area can have an atv QSO. 526.25 mHz is usually used for the simplex frequency, 434.0 repeater input, and 1253 mHz for the repeater output. While there is 9 db more path loss on 1200 vs 400 mHz, this is made up by having the tuneable downconverter mounted at the antenna which saves the feed line oss, and by smaller but higher gain antennas. The 1296-LY 28 element loop yagi for example has about 18 dbd gain. Having the repeater outputs on 1200 mHz also allows more repeaters in adjacent areas to operate without interferance. There is enough spectrum to have outputs or even intertie links on 1241, 1253, 1265, 1277, or 1289 mHz.

CHECK OUT THE SITE

Once you have determined its worth while to put up a repeater, take the time to thoroughly test out the site. Set up a time when those in the area to be served can give you a report on how well you are getting out from the site. Take your rig, camera, and omni antenna up to the site along with maybe a two meter HT for talk back. This way you can get a idea whether or not that site will do the job or find another. Note how well the more distant or non line of sight stations are received, and at the same time talk their picture in for strongest signal so they can mark it on their antenna rotator for when the machine goes up.

Other site considerations are what other repeaters, frequencies, and power levels are also there. You may find there are harmonic or intermods on the input frequency that could give trouble. Do the tests during high activity periods or even have the other site users make test transmissions while you are there. If the site is on government land you may have to apply for a special use permit from the responsible government agency. Usually the agency will circulate your request to all other site users giving a short period of time to reply with any objections. Don't worry about the off frequency overloads as the PSF-434-ATV interdigital filter should take care of them. The W6ºRG repeater is in the same building with 4 remote bases. The 434 mHz receive antenna is 15 ft. away from a 50 watt output FM remote on 448 mHz but you can't tell its on even with a weak 1 microvolt video signal input.

ANTENNAS

The antennas and their placement is the second most important consideration for a successful repeater next to the site selection. Vertical polarization is used for repeaters for two reasons. The first is the availability of omnidirectional gain antennas thanks to commercial and amateur FM. Its much easier to get gain and omni direction in the vertical mode. The handbooks are full of them and their theory which we won't go into. The most popular is the Phelps Dodge PD-455 Station Master, with about 9 DB of gain. These are over $200 apiece but are really worth it. If you have a small budget you might consider the AEA 450 Isopole which gives around 5 dbd gain for under $100. All these antennas get their gain by compressing the vertical lobe with multiple elements phased on the same feed point. Also they are well decoupled from the coax

feed so that all the energy goes out on the horizon rather than tilted up into the air.

Horizontal omni antennas ar a compromise of radiation efficiency to bend around dipole elements to get some sort of omni radiation. The vertical lobe must still be compressed to get the gain, so they usually take the form of many phased one above the other or special zig-zag. Broadcast UHF TV use them but they can afford the large arrays for the same gain. Attempts to properly phase many small beams usually end up with low gain main lobes and many nulls, but worst of all poor receiver to transmitter isolation.

Second, remember old demon desense and the 147 db requirement? Well each interdigital filter will give you at least 50 db each but the other 47 must come from antenna separation. Even more if you run higher power later. The null with two vertical omni gain antennas occurs when they are placed one directly above the other. According to Phelps Dodge, 20 ft. vertical separation will give 50 db at 450 mHz. However the same 50 db won't be had with horizontal separation until 400 ft. So the choice is either antennas, polarization, and placement for minimum radiation between omni antennas placed one above the other, or go split site with some link between.

THE SIMPLEST ATV REPEATER SYSTEM

ATV and UHF are not really difficult and gear is available, but to be successful you have to be exact in your construction and components used. While you might be able to hear a ZL in New Zealand on 20 meters with only a clip lead to your bead springs, you may get lousy video if improper shortcuts are taken.

TRANSMISSION LINES

At 450 mHz, a quarter wave length is only about 6 inches. If the coax does not stay 50 ohms along its length for as little as ¼ inch, the resulting VSWR and loss in significant. For this reason much attention should be given to putting the coax connectors on properly. Again we mention the old demon desense, as it seems silly to put all the money into good filters and antennas and throw the hard earned dbs away with poor connections, weatherproofing, and shielding. The transmission line must be as close to 100% shielded as possible. For this reason only good 50 ohm copper hardline or double shielded coax, such as RG214 or RG9 should be used all the way between the antennas and the filters. VSWR may radiate down the outside of the coax and couple into the receiving antenna, or even feed around the filter and get into other parts of the circuitry.

FILTERS

Especially for inband repeaters or sites with other UHF FM machines, filters on both the transmitter and receiver are required. Its usually easily understood why a good filter must be put on the receiver, but every transmitter has some sideband harmonics and broadband noise that may fall into the receivers passband. Spectrum International designed a 5 active pole interdigital filter for ATV that meets the requirement of steep attenuation slopes or shape factor but has low inband ripple and loss over a 5 mHz bandwidth. It is a difficult filter to copy let alone tune without the aid of a network analyzer but some info on a similiar 4 pole design can be found in the RSGB VHF-UHF Manual 3rd ed. Inband flatness is essential to insure that the phase of the color doesn't get shifted by the filter roll off. The color tint and hue can be changed if the filter response is not correct. Early atv repeaters sacrificed good resolution, color, and sound because they had to use available cavity filters. But today with so many using color computers, cameras, and vcrs on ATV there is no reason, with the interdigital filter, to restrict the quality video to simplex.

In the case of the crossband repeater, the vestigial sideband interdigital filter is required on the receiver, but only a simpler, wider interdigital filter (PSF-1265) is required on the transmitter to kill what little subharmonics sidebands may get out of the varactor tripler. In fact the only difference between the diagramed inband repeater is the addition of the varactor tripler and its filter, and a homebrew version of the Phelps Dodge PD-455 made out of brass tubing for 1253 mHz.

THE DOWNCONVERTER

Only good crystal controlled low noise downconverts should be considered for the repeater. We use the Spectrum International MMC439-ATV downconverter for example. A good point to remember is that you won't be there to give a fine tweek everytime something drifts. A temperature regulated site helps a lot, but even the best free running LO won't be good enough at temperature extremes from summer to winter. Also for this reason downconverting to the 45.75 mHz IF is suggested so that the VHF tuner drift won't enter into the picture. Signals from local commercial TV will probably be much stronger on the hill top site so using the IF instead of channel 3 will eliminate the possibility of strong channel 2 or 4 from riding in.

For proper system gain using the 45.75 mHz IF input, some of the VHF tuner gain must be made up for. So the selected downconverter must have at least 25 db of gain as well as a noise figure of less than 2 db. Too much gain may cause intermod interferance if some of the out of band signals get thru the filter and overload the mixer. Again the downconverter must be completely shielded, capacitive feedthrus for power, and all coaxes must be double shielded. RG55 is a good small sized double shielded coax to use between the filter and the downconverter. The LO has to be on the high side so as to invert the desired USB to LSB passband found in TV sets. If channel 3 is used then the LO must be on the low side as the vhf tuner will invert it.

TV RECEIVER

A good portable AC/12VDC TV is usually used for the receiver because the monitor is essentially free and is one less piece of gear to haul up to the site for testing or adjustment, and its ready to go at relatively low cost. Today many TVs have video and audio inputs and outputs built in to mate up with VCRs which means no video buffers and digging into the TV circuitry is necessary to bring them out. Also if these outputs are built in, the manufacturer had to have paid more attention to the IF alignment in order to get good color response on the monitor output.

The Liberty model 5010 shown in the block diagram is a 5 inch color portable, available from P.C. Electronics, which lends itself nicely to mounting in a 7 inch high rack panel. But the selected TV does not have to be a color set to pass color. A black and white set will work fine but will probably have to have its IF response re-tweeked for a flat 4 mHz response. This will also be true if any other IF strip module is used. Which ever set you select, get a service manual on it so that you can properly adjust the right tuned circuits and traps for the best resolution and color response.

If the set doesn't have a video output, one can be added usually with a P.C. Electronics VA-2 Video Distribution amp connected just after the video detector. Most TV schematics show a scope video test point with a wave form between .5 and 2 volts peak to peak. Note whether or not the sync is negative going or positive going at that point and jumper the phase on the VA-2 accordingly, and then adjust its gain pot for 1 volt peak to peak into a 75 ohm load. Place the VA-2 as close to the tap point as possible to minimize any flyback transformer radiation from being picked up on the input. Bring the video out thru a 75 ohm cable to connect to the sync operated relay that turns on the repeater, and to the transmitter or other special affects boards that might be added later.

Make sure that the set uses a power transformer and is not hot to the AC line. Hot chassis sets can be used but will require a AC isolation transformer so that smoke will not rise when any ground connection is made to the chasis or your hair strand straight out when you touch it.

If channel 3 is used, connect the 75 ohm coax from the downconverter directly to the antenna input of the VHF tuner. Do not just run it thru a balun to the twin lead screw terminals on the back. The internal twin lead from the back panel to the tuner is too much of a antenna for possibly picking up interferance from strong channel 2 or 4 stations. If the VHF tuner has a balun on it, remove it and connect the coax directly to its output as it goes into the tuner.

To use the 45.75 mHz IF for the downconverter input, find the lead between the VHF tuner and the IF input, break it and connect the 75 ohm coax from the downconverter to that point. Most TVs made for portable use (actual portable on batteries or plugged into 12 volt systems in cars and RVs, not just because it has a handle on it) have better sensitivity and plenty of gain so that the 25 db of gain in the downconverter is sufficient. But if it is not, a single stage amp at 45.75 mHz such as the Advanced Receiver Research PCH45VD can be add to make up for it rather than risk intermod with a 450 preamp. At this point, have another station transmit a good snow free color picture to you. Connect up on the bench the filter, downconverter, and TV plus your station atv antenna. Look at the monitor output on a scope and see if the color burst on the bakc porch of the horizontal sync is about .3 volts peak to peak when the total fully modulated video output waveform is 1.0 volts p-p. If not then there may be some roll off somewhere in the system that needs adjustment. Dont worry about the 4.5 mHz sound subcarrier level being down, in most TV sets its purposely rolled off in the IF 15 to 20 DB and finally trapped out in the video amp to prevent any intermod beat between it and the color subcarrier.

The sound may be rolled off 20 db in the IF but the sensitivity is about equal to the video due to the narrower bandwidth in the sound IF. In theory anyway, but here again poor IF alignment at the factory can result in one TV having fine sound with 30% snow and another barely audible with 10% snow. One other factor on simplex is that we run double sideband and depending on the alignment again, if both sidebands arrive at the sound IF limiter within 6 db of each other and out of phase, there may be some cancellation. This is not a problem with the repeater receiver because the interdigital filter drops the LSB sound subcarrier about 40 db or more.

Adding an interdigital filter at the home station is a little expensive. A much easier cure is to either check the TV IF alignment or add a simple series tuned suckout circuit at the video IF input tuned to 50.25 mHz. This can consist of a .47 microhenry inductor in series to ground with a trimmer cap or combination trimmer cap and fixed cap to give the total capacity of 21 PF. The inductor can be made from winding 12 turns of #24 wire on a ¼" drill ⅜" long. The caps can be a 1-10 pf variable in parellel with a 15 pf silver mica. Start at minimum capacity, and slowly tune down until the sound improves on a weak signal. If you go too far the video will be affected. Another method is to use a grid dipper and a counter for precise setting.

Sound out of a TV with audio output is usually around 1 volt p-p into 10K and is independant of the volume control. This is fine for the repeater and no further modifications or adjustments are necessary to the set. If there is no audio output, you will have to consult the service manual schematic for a point to tap into for a level of .1 to 1 volt. If the TV uses a DC volume control that is part of the sound IF chip then you will have to adjust the volume control for a adequate level for the repeater and put a speaker L pad between the TV and its internal speaker to be able to turn the speaker down when you leave the site. One other consideration is the de-emphasis network. This is usually found close to the sound detector output and therefore before the point you will tap. The curve for TV is 75 microseconds which has little affect on voice response unlike FM communications which starts at 300 Hz. So while tapping in before or after won't make much difference to the voice response, it will give more high frequency hiss and noise if the tap is before the de-emphasis RC filter.

Some sets seem to have more intercarrier sound buzz than others, and this again is due to poor alignment at the factory. Make sure the discriminator balance or quadarature detector is right on 4.5 mHz tuned circuits in the sound IF circuit. When there is over modulation or lots of white in the picture, the sound IF limiters may go in and out of limiting at the picture scan rates which give the resulting buzz. Since the white level is the lowest power swing of the video, the limiters need to have all the signal they can get to level off the AM variations.

Most will not have a scope and TV sweep gen to do a accurate alignment. What you might do is to get all the local atvers together with one of the local TV repair shops, especially if the owner is a ham, and have a alignment party on the weekend. You may have to pay for his shop time, but with the whole group there to watch and pick his brain, it will be well worth it.

SYNC OPERATED RELAY

The repeater should key up only in the presence of video and not from, FM, radar, etc. that kicks up the AGC. To do this a PLL 567 decoder is used to detect the 15734 Hz horizontal sync. When the horizontal sync is detected, the DPDT relay will pull in. The relay contacts control the application of regulated 13.8 VDC to the transmitter. The output of the 567 is a series of spikes at the 15 kHz rate for a short duration upon application of a video waveform. To keep the output from chattering, some hysterisis is added to give a little keyup and dropout delay. This smooths out the keyup and gives some more noise immunity.

The P.C. Electronics TD-1 Tone Decoder board uses available Radio Shack parts. Later on a fancier sync operated relay with provision for time limits, test patterns, video IDs, etc can be added, but this should be done only after all the bugs are out of the basic repeater and its had at least 6 continuous weeks of unattended operation with no problems.

REPEATER TRANSMITTER MODULE

The P.C. Electronics RTX-1 is made up of atv modules mounted in a Hammond 1590D die cast aluminum box measuring 7.3x4.7x2.0 inches. Bud also makes a equivalent.

These boxes are very tight RF wise and also are a good heat sink. All the power and signal leads come out thru 500 pf ceramic feedthru caps. This tight box is necessary again to prevent leakage RF from getting to the receiver. I mounted the RTX-1 transmitter module in a 3x12x15 aluminum chassis along with the sync operated relay and 3 amp power supply. There is plenty of room left over for later additions. The chassis is attached to a 3.5" 19 inch rack panel for mounting. The RTX-1 bottom is covered with silicon heat sink compound before mounting to the aluminum chassis to make sure the heat is conducted out.

A 1" diameter hole can be punched in the back of the chassis to allow access to the RF output BNC connector. A short RG55 double shielded 50 ohm coax is run from this output to the PSF-421-ATV vestigial sideband filter. In the case of the crossband repeater it will go to the MMV-1253 varactor tripler and then thru another piece of RG55 to the PSF-1253 interdigital bandpass filter. The filters take BNC connectors so use only good constant impedance one step adaptors to transistion to the larger coax or hardline.

Also along the back of the chassis you can put RCA jacks for the TV audio input and its 10K level pot, as well as up to 3 other uture audio inputs such as 2 meter FM simplex used for talkback (usually 146.43 or 147.51 mHz), MCW call IDer, weather radio, etc. The minimum audio level into these inputs is .2 volts p-p into 10K for full 25 kHz deviation. The 10 pots allow independant mixed levels. Usually the TV audio is set for full 25 kHz deviation and the others down 10 db or so as not to drown out the incoming audio but enough to be heard.

The video from the TV monitor output can be put on the front panel or rear depending on how you want to route it from the TV, or special effects card cage later. Although once the modulation pot on the TXA5 exciter/modulator has been set with a 1 volt p-p video signal, all feeds should be adjusted for that level rather than trying to readjust everytime a new piece of gear is added.

The DM-1 monitor output is optional if you are building your own from modules, but is really handy for setting levels out of the transmitter with a scope and a video monitor. A mic jack on the front panel will also give you duplex audio while making ajdustments at the repeater site. It mixes with the other audios that go to the FMA5 subcarrier gen. Don't forget and leave it plugged in when you leave the site or you will hear every cricket in the county that night!

The power supply is made up from Radio Shack parts. The LM350K or LM350T adjustable regulator can also be mounted on the back of the chassis with a mica spacer and heat sink compound. A center off dpst toggle switch provides the mode switching to enable easy testing at the site. It can be switched for constant transmit or receive only as well as normal repeat mode.

The P.C. Electronics TXA5, MHW710-2 power module, FMA5, and DM-1 are shown elsewhere in this book and are shown as blocks connected by RG 174 50 ohm coax inside the die cast aluminum box.

WHISTLES AND BELLS

Getting it all working and installed will take some time but the reward of seeing a good RF system reliably operating will be worth it. Do not be tempted to add amplifiers, IDs, etc. until the basic RF system is up and running for a while. If you do you might be overwhelmed by too many system problems and interactions to properly trouble shoot them. One step at a time will pay off in the long run. There have been many with great ideas for a machine who end up many dollars and years later with nothing but a rack full of junk that is poorly functional at best.

Adding video or audio functions and effects is now as easy as unplugging the shielded cables between the TV and the transmitter panel, and looping them thru the effects card cage or chassis. If it doesn't work quite right when you get it up at the site, then just re-plug in the two cables to the transmitter rack, take the effects module home to trouble shoot and try again next week. But you will not catch hell from the local users for being down in the mean time. The joys of being a repeater owner are another story all together.

Once up and running the possibilities are endless. Here are a few to get your thinking cap dreaming:

Computer games. Use the sound subcarrier for RTTY, ASCII, or cassette interface from users keyboards or TTYs to access the computer at the site to come over the repeater output.

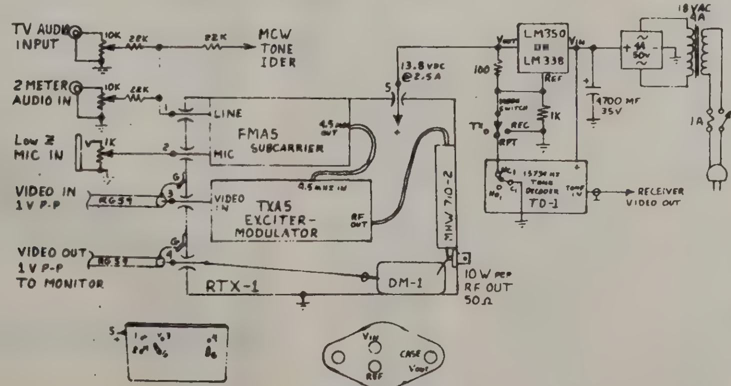
Weather watch. Key on with touch tones on the sound subcarrier the local weather watch or GOES weather satellite video on the repeater output. VHF weather can also be keyed on to the sound subcarrier.

The CBG-3 color bar and pattern gen can be keyed in to give test patterns for TV alignment and tests. It can also be set to come on for a minute or two automatically after a station unkeys. Time, call ID, and relative signal strength can also be automatically superimposed on the test pattern with the VDM-3, VID-3, and other boards.

All kinds of audios can be switched in and out, including a MCW ID at the beginning of each key up. The two meter talk back is very handy for duplex audio with the station you are working. If he is out of 2 meter range but can see the repeater, then its like having a remote 2 meter receiver on the hill top that enables you to hear his comments on your video while you are on and talking to him on the sound subcarrier.

I could go on and on, but you get the picture?

W6ORG (c) 3/82
Tom O'Hara

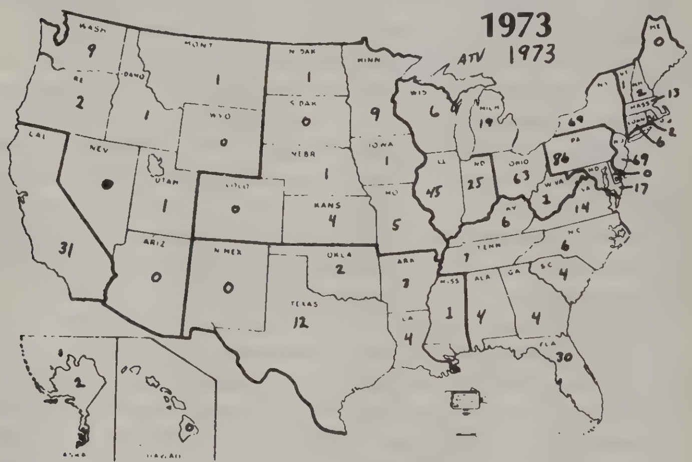


LM350K Bottom View

CHAPTER 12
AMATEUR TELEVISION ACTIVITY
Repeaters, Clubs and Groups

Amateur Television "repeaters" have played a major role in the growth of FSTV. ATV activity varies between simplex and repeater operation, horizontal versus vertical polarization across the country. Thanks to the persistant efforts of Bruce Brown and the famous "Metrovision ATV Club," ATV saw its' first licensed FCC FSTV Repeater "WR4AAG" serving the greater Washington, D.C./Baltimore, MD. area. Today, there are over 60 known ATV relaying facilities throughout the world. The trend toward specialized communications by Amateurs along with the rapid development of the state-of-art will provide for steady growth in the ATV field. It is just a matter of time before the first "handheld ATV" units are developed providing both audio and video picture reception and transmissions. The future of ATV looks very exciting, and the thing to do is to be a part of it!

As presented below, is a study comparison of known ATV activity in the United States as published in 1973 and a look at today's ATV activity in 1982. These figures were compiled from subscription files of A5 AMATEUR TELEVISION MAGAZINE, various surveys conducted within the past two years, Club and Group activity reports, etc. This is the most accurate estimate of FSTV activity within the United States. Erors that exist will only boost the numbers per state given. It is estimated that over 3,000 Amateurs operate FSTV in the United States with perhaps 5,000 worldwide. This relates to about **1%** of the total Amateur Radio population and with other modes of A5 emissions such as SSTV increases to about a 2-3% figure.



Known United States FSTV
Stations April 1982
Information compiled from A5 Magazine subscription files, surveys, ATV club rosters, reporting groups, etc.

FSTV GROWTH STUDY BY A5 ATV MAGAZINE

*** Designate Known ATV Repeater Locations**

A5 ATV MAGAZINE "1982" USA FSTV REPEATER DIRECTORY

Status A — Active T — Testi...

CALLSIGN	LOCATION	VIDEO INPUT	VIDEO OUTPUT	AUDIO INPUT	AUDIO OUTPUT	MODE	RF	D	SPONSOR	SOURCE
WR1AHH	Groton, Connecticut	439.25	427.25	443.75	431.75	BW	—	A	Radio Group	WA1PTS
W1NRE	New Haven, Connecticut	439.25	427.25	443.75	430.75	BW	—	A	SCARA	WA1LOU
K1BYO	Naugatuck, Connecticut	439.25	426.25	443.75	430.75	BW	—	A	K1BYD	WA1LOV
K1VTE	Malden (Boston), Mass.	439.25	434.0	—	—	BW C	180	A	Neat	W1BHD
K2PG	Iselin, New Jersey	439.25	427.25	—	—	BW	—	A	NJATV	K2M2
WR2ADD	Mount Kipp, New Jersey	439.25	526.25	443.75	430.75	BW	—	A	NJATV	K2M2
W2VDE	Warren, New Jersey	439.25	426.25	—	—	BW	—	A	NJATV	K2M2
N2BJ	Garnerville, New York	439.25	426,25	—	—	BW	—	A	—	—
WA2IUP	New York, New York	439.25	426.25	443.75	430.75	BW C	—	A	NYATV	K2M2
—	Mount Beacon, New York	439.25	426.25	—	—	BW C	—	T	Mount Beacon	WB2WLN
WB2FCN	Rochester City, New York	439.25	427.25	—	—	BW	—	A	NYATV	WB2FCN
WR2AOV	Syosset, New York	439.25	426.25	443.75	430.75	BW	—	A	NYATV	K2M2
W3WCQ	Baltimore, Maryland	439.25	426.25	—	—	BW	—	A	BATV Society	W3WCQ
WA3KXG	Harrisburg, PA	439.25	426.25	443.75	430.75	BW	—	A	CPRA	WA3AVX
K3SPI	Johnstown, PA	439.25	427.25	—	—	BW	—	A	CVARC	K3SPI
W3PHL	Philadelphia, PA	439.25	421.25	443.75	425.75	BW	—	A	PARA	K3TS
W4BJG	Birmingham, Alabama	439.25	427.25	—	—	BW	—	A	W4BJG	WA4ZVJ
W4ATD	Decatur, Georgia	439½25	427.25	—	—	BW	—	A	W4ATD	WA4ZVJ
K4OQ	Clearwater, Florida	439.25	427.25	443.75	431.75	BW	40	A	FATV	WB4BNJ
WR4AYC	Fort Lauderdale, Florida	439.25	427.75	443.75	431.75	BW	—	A	—	—
W4TOD	Orlando, Florida	439.25	427.75	443.75	431.75	BW	—	A	—	W4PLA
WR4AEE	Melbourne, Florida	439.25	425.25	—	—	BW	—	A	FRC	W4OER
WR4AAG*	Alexandria, Virginia	439.25	426.25	443.75	430.75	BW C	—	A	Metrovision	TMARC
WA420K	Chattanooga, Tenn.	439.25	427.25	443.75	431.75	BW	—	A	CURA	WA42OK
K4DTM	Greenville, Tenn.	439.25	427.25	—	—	BW	—	A	CURA	K40TM
WB5OCY	Albuquerque, N. Mexico	439.25	427.25	—	—	BW	—	A	NMATV	W5HK
K5PJR	Grove, Oklahoma	439.25	427.25	—	—	BW	—	A	ORSI	W5DFU
WA5LVT	Tulsa, Oklahoma	439.425	427.25	—	—	BW	—	A	ORSI	W5DFU
N5ABG	Beaumont, Texas	439.25	427.25	—	—	BW	—	A	N5ABG	WB5ITT
WA6RDA	Sanoma/Bay Area, Calif.	434.0	421.25	440.50	425.75	BW C	25	T	BAYREAATV	WA6RDA
WA6RDA	Sanoma (Bay Area, Calif.	434.0	1263	—	—	BW C	35	T	WA6RDA	WA6RDA
W6NFK	Mt. Diablo, Calif.	1275	434	146.43	—	BW C	—	T	BAYARGA ATV	W6NFK
W6ORG	Johnstone Peak, Calif	434.0	1265	438.0	1269.5	BW C	25	A	W6ORG	W6ORG
N6AHW	Monterey Penn. Calif.	439.25	427.25	—	—	BW	—	A	—	N6AHW
W6NFK	Oakland, Calif.	439.25	425.25	—	—	BW	—	A	ContraCostaAT	W6NFK
WA6SVT	Mt. Wilson, Calif.	434.0	1253	438.0	1257.5	BW C	25	A	SCALATV	WA6SVT
W7HLG	Tucson, Arizona	437.5	438.0	1265	1269.5	BW	30	A	—	E.K.Moore
WA7UMH	Glendale, Arizona	1253	434	147.58	—	BW	—	A	AAA5	N7AOV
WR7ALW	Alpino, Utah	439.25	427.35	—	—	BW	—	A	—	K7GRC
W8BI	Dayton, Ohio	439.25	426.25	443.75	431.75	BW C	—	A	DAytonARC	WA8MCH
W8GM	East Palestine, Ohio	434.0	421.75	—	—	BW	90	A	EPARC	KE8S
K9KTH	Bloomington, Indiana	439.75	425.25	443.75	430.25	BW C	—	A	BBSRC	K9KTH
WR9ABP	Indianapolis, Indiana	439.25	425.25	443.75	430.25	BW	—	A	IRC	W9NTP
AD9W	Wausau, Wisconsin	439.25	421.25	—	—	BW	—	A	WAR	AD9W
K0SVH	Walcott, Iowa	439.25	421.25	443.75	425.75	BW	60	T	SEIATV	WB0QCD
WA0ADA	Boulder, Colorado	439.25	421.25	443.75	425.75	BW	—	A	Rocky Mtn	WA0NHD
K0JOA	West Phoenix, Ariz.	434	2380	—	—	BW	—	T	—	K0JOA
—	Minn. St. Paul, Minn	439.25	—	147.57	—	BW	—	A	—	KK0O
—	Witchita, Kansas	436	—	—	—	BW	—	A	—	WA0NGV

KNOWN FSTV GROUPS, CLUBS, ORGANIZATIONS (NON-REPEATER) MIDWEST AREA

AREA	ATV Group Est Club	ATV Freq. Used	Sub Carrier	On Carrier	2 Meter Auxiliary	Color	Contact
Chicago, ILL	Midwest ATV	439.25	443.75	439.25	144.58	H	WA9EON
Chicago, ILL	ATV-DX'ers	436.0	443.75	436.0	144.34	H	W9Z1H
Peoria, ILL	ATV'ers	439.25	443.75	—	144.34	H	K9ILA
Canton, ILL	ATV-DX'ers	439.25	443.75	—	143.44	H	N9GA
Springfield, ILL	Downstate ATV'ers	439.25	443.75	—	144.34	H	K9KKL
Moline, ILL	Quad-City ATV'ers	439.25/436.0	443.75	439.25	144.34	H	N9AEP
Muscatine, IA	Warermelon City ATV'ers	439.25	447.75	439.25	144.34	H	WB0MEW
Cedar Rapids, IA	ATV'ers	439.25	443.75	—	146.600		WB0VVZ
Waterloo, IA	ATV'ers	439.25	443.75	—	146.82		WA0INC
Des Moines, IA	ATV'ers	439.25	443.75	—	VNK		K0IXR
St. Louis, MO	ATVDX'ers	439.25/436	443.75	436.0	144.150	H	WB0ZJP
Milwaukee, Wisc.	ATV'ers	439.25/436.0	443.75	436.0	144.34	H	K9KLM
Western Penn.	PADX'ers	439.25/436	443.75	436.00	144.34	H	W3POS
Waldron, Ind.	Indiana DX'ers	439.25/436	443.75	436	144.34	H	W9NTP
Minneapolis, Minn	DX'ers	439.25	443.75	439.25	147.57	H	KK0O

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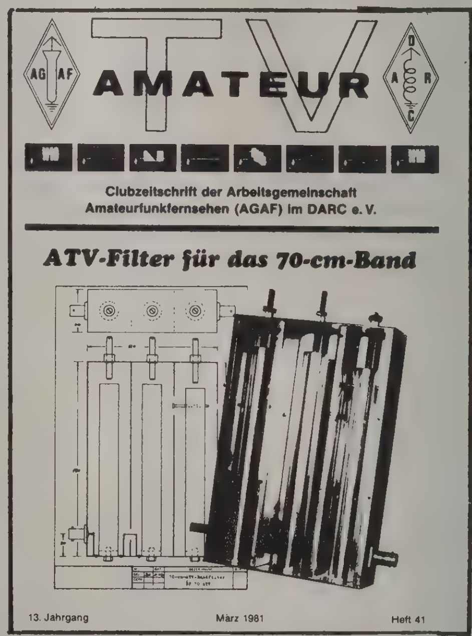

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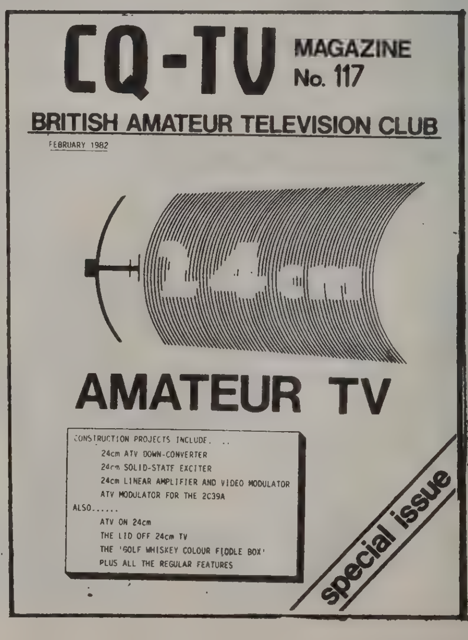
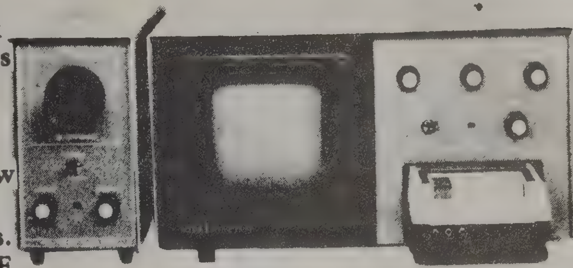
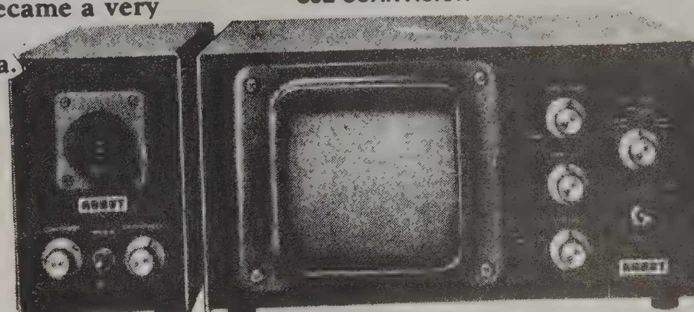


REMEMBERING SSTV JUST A FEW YEARS AGO...

Early pioneering in SSTV actually began with facsimile (FAX) experimentations back in the 1930's when commercial broadcasters transmitted FAX signals in the form of pictures, news items and advertising to those few who purchased or homebrewed special receiving converters. The 1960's saw the first developments of SSTV using the yellow and green P-7 tubes for visual displays. The SBE SCANVISION SSTV Converter by SBE LINEAR SYSTEMS, INC. of Watsonville, California became a very sought after TV system featuring a plug in and already wired audio cassette system and matching SSTV camera. These unique units can still be found today at larger Amateur retailers for reasonable costs and act as an excellent secondary or backup system for SSTV operators. The photo of the man in the upper left corner best represents the type of viewed SSTV pictures that this type of system would receive and display. The first of a series of ROBOT SSTV SCAN CONVERTERS started with the model 70 units. Higher resolution was accomplished up to 256 pixels and lines at a slower clocking rate and was for many years accepted as the "latest" in SSTV technology. A matching model 80A camera and many "modifications" followed as SSTV'ers were for the first time getting some really enjoyable photographs on the new video mode on Amateur bands. About this same time Mike Tallent of California and a few others around the country started applying the new technology of micro-processors and intergrated circuits (IC's) to SSTV and came up with the first "digitized" circuit boards that displayed the incoming SSTV pictures without "fadeouts" on a conventional TV set or monitor. Other O-scope modifications gained in popularity with these new smaller circuits. Copthorne MacDonald in 1957 while a student at the University of Kentucky took his love for HF ham-radio and his ingenuity to come up with a way to transmit pictures over-the-air to create SSTV to what it has become today. His further lobbying efforts and battle with the FCC eventually led to the establishment of the SSTV mode and legal transmissions on the DX bands. ROBOT RESEARCH in Californis kept up there fine work on a "digitized" system and after a short release of a ROBOT 300 system, came out with the current ROBOT 400 SSTV CONVERTER which dominates the world market in both Amateur and Commercial SSTV Scan Converters. TRaditional to the "ham" user restlessness, many modifications have since been published on the popular 400 model scan converter. Not too long after the digital units started selling well to Amateurs, DL2RZ in Germany updated his SC-420 series units for even more features not found in American made units. 1983/84 promises new scan converters by WRAASE units. His latest SSTVSC-422A model remains as the "cadillac" of SSTV converters for Amateurs and was official ly brought into the U.S. marketplace after an "A5" review by KW Control Systems, Inc. of New York. Admittingly with a very high price tag, the WRAASE units are competitive when compared feature for feature and with the actual cost of compared scan converter included in the study. Color SSTV is not generally known by SSTV'ers to have been around for many years. Howard McAfee and Sam Mormino (KD6HF/WA7WOD) have been the promoters of ROBOT 400 type of Color SSTV with their 3000C modification boards. Syd Horne VE3EGO of Canada followed shortly with an even more updated approach to converting the ROBOT 400 scan-converter (pictured) all under "one roof"! George Steber WB9LVI of Wisconsin saw the need for a more improved black/white system with higher resolution at competitive prices and in March of 1982 released first details of the new VIDEOSCAN 1000 units. Offered in assembled ready-to-go or "kit" form, dozens of new VS-1000 scanconverters are on the air operating today. Not to ignore the use of microcomputers, several systems, interfaces and programs are now on the market for SSTV use are far less cost than hardware systems per mode.



SBE SCANVISION

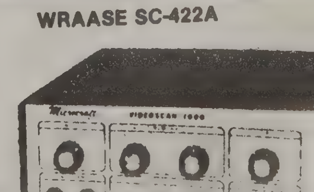


Model 7D/80A

ROBOT RESEARCH INC.
Model 400

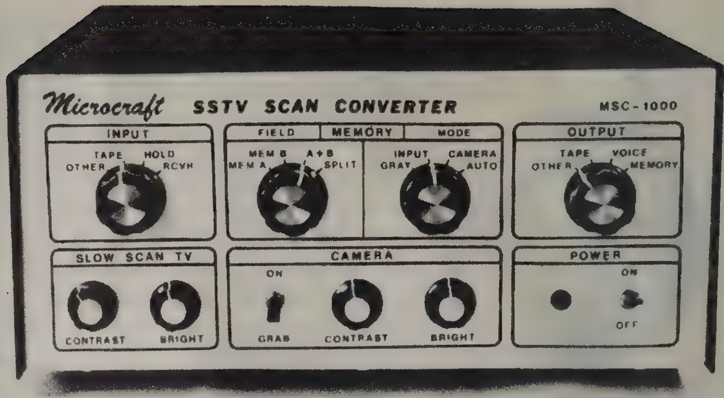
Colorscan 403

WRAASE SC-422A



VIDEOSCAN 1000

WB9LVI



CHAPTER 12

GETTING STARTED IN SLOW SCAN TV

by Dr. George Stober, WB9LVI

Slow scan television (SSTV) is an exciting medium for amateur radio operators. Whether you are an inactive ham who has lost interest or an active amateur looking for new challenges, SSTV is the answer. If you can operate a home TV Camera and adjust a TV monitor you have the necessary skills to operate SSTV on the amateur radio bands.

Presented below are generalized answers to questions often asked by people not involved in slow scan TV. Hopefully this information will help you decide if you want to get into this wonderful world of amateur slow scan television.

What is the difference between "regular TV" and SSTV? The bandwidth required for regular TV (sometimes called fast scan TV or FSTV) is about 4.5 Mhz. This bandwidth is more than all the combined h.f. bands available to U.S. amateurs! So from a technical point of view FSTV on these bands is not practical for amateurs.

SSTV, however, uses only a 3 Khz bandwidth which permits transmission of pictures over voice grade radio channels. This narrow bandwidth will not allow the transmission of motion. However, good quality "still" pictures can be transmitted in reasonably short periods. Transmission times vary from 8 seconds, for amateur-standard low resolution pictures, to 34 seconds for high resolution pictures.

Are special receivers and transmitters needed for SSTV? Definitely not! You can use your regular ham station SSB receiver and transmitter (or transceiver) to operate SSTV.

The SSTV signal is fed directly to the microphone input of your transmitter. For reception the SSTV signals are coupled from the audio output of your receiver. SSTV gear can be regarded as an add-on to your existing station, like RTTY gear. You just add a few cables, a TV camera and TV monitor.

Who can operate SSTV? Any technician (UHF frequencies and above), general, advanced or extra class amateur can operate SSTV. SSTV operation is restricted to the phone portion of the bands. Generally speaking a licensed U.S. ham can operate SSTV on the same frequencies he uses for phone. As of May 22, 1983, generals were given permission to run SSTV into the new FCC expanded frequencies on the HF bands, which brings everyone at 14.230 Mhz. (FCC Docket 82-83.)

Is there much SSTV activity? There are over 15,000 SSTV stations in over 100 countries around the world. Imagine receiving pictures from England, germany, New Zealand, Italy, Canada, Mexico, South America, Japan or Africa. DXCC on slow scan is a worthy goal and has already been achieved by several amateurs.

What kind of pictures are seen on SSTV? Pictures vary considerably depending on the personality of the operator. Pictures of the operator and the ham shack probably top the list. Other SSTVers specialize in cartoon subjects, family photos or vacation pictures. Even home computers can generate SSTV by means of special interfaces.

Pictures of the planets from U.S. spacecraft are transmitted regularly by N6V a specially licensed station at the Jet Propulsion Labs in California. These pictures are of historic value and are usually transmitted only minutes after being received on Earth.

Are there any SSTV nets? The most popular net is the Saturday afternoon SSTV network that meets at 1800 GMT on 14.230 Mhz. Call-ins with or without SSTV gear are welcome. Slow scanners are a friendly group and are happy to answer your questions about SSTV.

What is a scan converter? A scan converter is a device to convert FSTV signals to SSTV and vice-versa.

A scan converter provides several useful functions. Included is a digital memory used to store one or more SSTV pictures. These SSTV pictures can be displayed on an ordinary FSTV monitor. The scan converter also allows a regular FSTV camera to be used to grab pictures into memory.

What is high resolution SSTV? SSTV has evolved as a low resolution medium of communication because of the technology required. First generation scan converters were capable of storing only 128 line pictures of 128 pixels per line with each picture element (pixel) quantized to 16 levels of gray. Newew Hi-Res. Converters like Microcrafts Videoscan 1000 produces much higher quality pictures because it utilizes 256 pixels per line and quantizes each pixel to 64 gray levels.

This unit also has two high resolution modes of 17 and 34 seconds which permit transmission of true 256 line pictures. This resolution rivals commercial TV quality and is extensively used for industrial applications.

Can I record my SSTV pictures? Definitely yes! A tape recorder is a basic tool for slow scanners. Since SSTV is an audio medium the signals can be recorded with an audio tape recorder. A recorder and tape that provide the smoothest tape movement is recommended. A recorder that is amune to RFI problems is a must.

You can tape a short program of your ham station or any other interesting program. Once you have composed your program on tape, you can play it back over and over again on the air. Some operators put CQ calls on tape so they do not have to set up the camera. And do not forget that you can record the other fellow's slow scan too. This allows you to make an excellent historic record.

What about color SSTV? Color SSTV, although an exciting prospect, is very experimental and expensive. Only a relatively few amateurs have experimented with it using modified or home brew gear. One of the main problems is that there are currently no standards for color transmissions. Other problems involve high cost of equipment and greatly extended transmission times needed. Color SSTV will come into its own.

¢How much power can I run on SSTV? Standard Amateur radio rules govern SSTV transmissions. SSTV like RTTY is a 100% duty cycle transmission. Therefore, you should check your transmitter's rating to see how much power it can handle in this mode. Continous ratings are usually much less than SSB ratings. You may have to adjust the level control of your transmitter to avoid overdriving it on SSTV.

Can I use SSTV on my telephone line? SSTV can be transmitted on the telephone to anyone in the world with SSTV equipment. You will need a phone patch or other interface equipment available from phone company to isolate and monitor power levels on the phone line. With this setup you can have your own private picture telephone. Whether you are in FSTV or other Amateur modes,you can't affort to miss out on the excitement of slow-scan Television!

SSTV THEORY

by Martin B. Weinstein

Yesterdays Experiments are Today's Visual Communications

☐ About two dozen years ago, a strange new warble was added to the dah-dih-dahs, buzzes and whistles on the Amateur bands. It was no convolution of a ham's voice, no alphabetic code, no teletypewriter signal; instead, hams were sending and receiving pictures of each other!

In the early days of this new mode, called Slow Scan Television, the picture shows resembled your Aunt Harriet's favorite vacation slides, or call letters pasted on *Playboy* pictorials. For many, a chalkboard or signs hastily crayoned on cardboard were the stars of the show.

But Slow Scan TV (or SSTV) has come a long way since those early days. There have been experiments with color, with 3-D, and with home computer-generated graphics.

Slow Scan Basics. It takes just a tad longer than 8½ seconds for a complete SSTV picture to appear. That's because SSTV is the result of a challenge met and conquered by its ham pioneers: to fit a video signal into the narrow bandwidth of a voice transmission. The bandwidth of an SSTV signal is only about 2500 Hz, which means it can be transmitted over voice channels like telephone lines and the amateur voice bands; compare that to the 4 to 6 *million* Hz of bandwidth required by a standard (fast scan) TV signal, which builds a complete picture thirty times a second—256 times as often.

This difference in *frame rate* was the first major concession these hams had to make in order to meet the narrowband challenge; the second was resolution.

You know that television pictures are made up of lines. A standard television picture (in the U.S.A.) includes a total of 525 lines from top to bottom. By comparison, an SSTV picture has only 128 lines from top to bottom. Also, while a standard TV picture has an *aspect* ratio of 4:3 (meaning it's ¾ as tall as it is wide), an SSTV picture has an aspect ratio of 1:1 (meaning it's square).

Audio to Video. In order to send and receive their pictures with standard ham transmitters and receivers, the SSTV pioneers were faced with the problem of how to *modulate* and *demodulate* the voltages that SSTV pictures are made of. For once, the easy and obvious answer worked! They decided to translate these voltages into tones (audio tones) for transmission, and to translate their received tones back into voltages.

In making this decision, they were also providing themselves with an easy way to record SSTV pictures—standard audio tape. Even the cheapest cassette recorders with reasonable speed stability proved capable performers.

In order to be sure that their signals would be compatible with each other's equipment, a set of standards was developed. The highest frequency, 2300 Hz, was set to represent white. Black was to be at 1500 Hz; and 1200 Hz, a blacker-than-black frequency, used for synchronization.

Sync Or Swim. Synchronization standards for SSTV were also crucial to its development. If a receiver didn't go to the next line exactly when the camera and transmitter did, the result would be a picture that swims—one with undulating edges and bits of one line appearing on the next. At best, the picture looked like it was printed on a balloon being stretched out of shape; at worst, it was indecipherable.

So sync standards were devolped using 60 Hz AC power line frequency as its standard, and provisions were made on SSTV monitors to de-skew slightly off-standard signals.

First, the 60 Hz signal was divided by 4 to come up with a 15 Hz line rate. Once every 1/15th second, a 5 millisecond burst of 1200 Hz sync signal (a total of only 6 cycles) is inserted onto the transmitted signal as a prompt to the receiving monitor to go to the next scan line.

DIGITAL SSTV BY JIM SCHUEKLER

VOLKER WRAASE SC-422A COLOR SSTV SYSTEM

This 15 Hz signal is again divided by 128, and once every 8.5333 seconds a 66 millisecond burst (80 cycles) of 1200 Hz sync tone is transmitted as a signal to start scanning a new picture (*raster*). In this way, exactly 128 lines are counted out for each picture.

SSTV provides a resolution of 128 dots (or *pixels*, short for picture elements) on each scan line. Theoretically, this means that each dot is transmitted during 1/128th of the period between sync pulses, which is 80/86th of 1/15th second. This, according to my pocket calculator, is 1/2064th of a second, meaning that pixels should appear at a 2064 Hz rate. In practice, this is difficult to achieve over a communications channel, but modern equipment has made it possible over closed circuits, and come close to it over the air as well.

Freezing The Image. Compared to the homebuilt receivers with long-persistence phosphor cathode ray tubes (their dim green glow had to be viewed in near darkness) that were the only way to watch SSTV in its early days, the state of the art has advanced by leaps and bounds. Today scan converters let you watch SSTV pictures on a standard TV monitor.

It works the other way, too. Camera tubes that could be scanned at SSTV rates are rare and expensive, so standard TV cameras are used and their signals sampled at SSTV scan rates. This offers the advantage of being able to see what the camera sees on a standard TV, even while transmitting slow scan.

As pictures change, a horizontal line proceeds from the top of the screen to the bottom. As it "wipes" down the screen, it discloses the new picture behind it. The new picture appears above the line, replacing the old picture which still can be seen below the line.

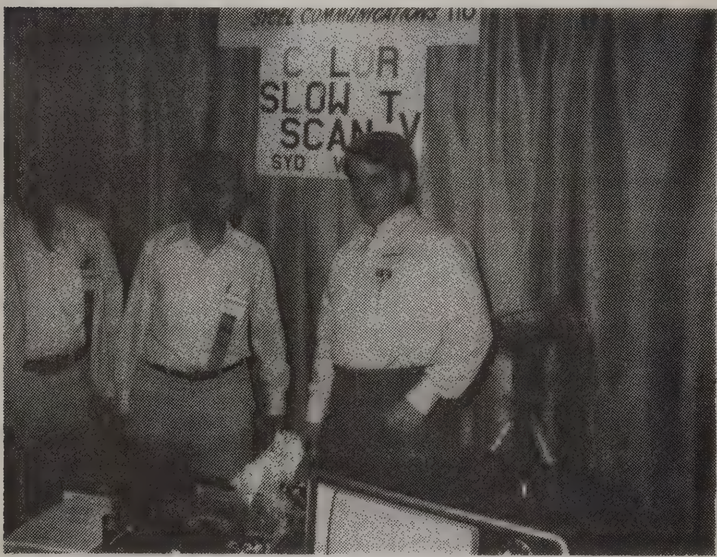
COLOR SSTV STANDARDS

Syd Horne VE3EGO
P.O. Box 893
Belleville, Ontario, Canada K82G6

Evidently there has been some confusion existing among SSTV enthusiasts concerning the standards for color SSTV. I disagree with the notion that any one person or group determines what standards will be adopted for SSTV. This is quite simply just not the case.

The original inventor of a particular color SSTV transmission method must of necessity specify the system parameters which would permit others to take part in the experimental activity and control the system parameters for that system until such time that the parameters for that system have been accepted by a majority of users as a standard.

It has been also suggested that compatibility has been forgotten. I do not believe this to be true. The following discussion is an attempt to clarify the situation.



VE3EGO Syd Horne and G3NOX Geremy Royale

FUTURE IMPROVED COLOR SSTV

Amateur experimenters who are working on Line Sequential SSTV systems which will enable a color picture to be painted with all three colors on a line by line basis, have recognized the fact that the green picture is best suited for viewing on a B/W monitor. Accordingly a proposal has been made to transmit line sequential SSTV with the green line first followed by the red and lbue lines for each three line sequence. The order of the red and blue lines will be determined by the system considerations. This line sequential SSTV transmission when encoded with appropriate synchronising pulses will enable an amateur with existing B/W equipment to receive these transmissions. This is the basic reason for the GRB sequence. The precise details of the GRB transmission sequence however, has not, to my knowledge, been published at this time. (Article written before Robert Studios W0LMD article in November A5, issue-Editor) This is the basic reason for the GRB sequence. In any event the exact sequence is of transmission of each line is somewhat unimportant because the switching required to generate the sequence must be generated electronically. Therefore, once the best sequence is determined for a compatible B/W and color system it can be standardized. In most systems it is a relatively trivial adjustment to change the sequence in which the lines are transmitted.

Many amateurs are experimenting with line sequential color SSTV systems. I am aware of experiments that are being conducted with systems that require frame transmission times of 8.12 and 25 seconds. These systems, by their experimental nature are proposals at this time. Any particular system will not become a standard until the system parameters have been published in detail to enable others to duplicate the results. In addition, a consensus must be reached that the overall picture quality is acceptable. This will take some time. Frankly, I am encouraged that this serious experimentation is taking place. We are very fortunate to have gifted people among our ranks who have devoted much time and thought to the solution of some very complex problems.

THINGS DESIGNERS SHOULD KEEP IN MIND

There are several important parameters to be considered in a color SSTV system. The most important parameter is picture quality. There is a communications law which states that for a given amount of information the bandwidth multiplied by the transmission time is a constant. This means what if it takes 25 seconds to transmit a RGB frame sequential picture and it is required to transmit the same picture in say 8 seconds then, since the bandwidth is the same, it follows that the amount of information must be reduced in order to send that picture in one third of the transmission time. This will, no doubt, affect picture qualityl. The main question is whether or not the resulting pictures, when produced using 8 or 12 second transmission times is subjectively acceptable to a large number of amateurs so as to encourage them to use the proposed standard. The jury is out on this question.

The transmission of color SSTV using relatively short frame times presents a tremendous challenge to the designers of newer systems. The designer must develop some clever approaches in this area. I also believe that if we cooperated to develop a new standard then the state of the art will be significantly advanced.

COMPATIBILITY IS A MUST!

The generally accepted meaning of compatibility is that all SSTV systems currently in use, will be capable of receiving every other SSTV transmission. Because of the large number of Robot 400 and other similar scan converters currently in use around the world it is mandatory that any new color SSTV standard must be compatible with existing standards. If we do not cooperate in this worthwhile endeavor then the SSTV community will get subdivided into smaller groups. This obviously is a backward step and must be avoided at all costs.

I will be interested in working with anyone in this endeavor.

Syd Horne VE3EGO

SSTV COLOUR—COMPOSITION & CORRECTION

BY Gerald KLATZKO ZS6BTD
P.O. Box 47171
Parklands - 2121
Republic of South Africa
(A5 Magazine Foreign Rep.)

PROPER LIGHTING OF SUBJECT MATERIAL

As can be seen from the attached drawing, Fig. 1, there are three projectors, each transmitting "white" light through a primary filter, i.e. RED, GREEN , BLUE. Where all three beams intersect, we obtain white light. In the case of colour SSTV, we do not project the light direct, but we receive it into the vidicon via a reflective surface, namely the colour photograph which we wish to transmit, colour graphic or any other coloured material that gives some reflection. The duller the material or the smaller the aperture (bigger F stop number) of the lens, the brighter our light source must be in order to activate the vidicon sufficiently. The reason for putting "white" in parenthesis is that "white" light from incandescent lamps is not white. Depending on the wattage of the lamp, it is either very red (at aorund 2000° Kelvin) or mildly red on a 2kW lamp at around 3600°K. A fluorescent lamp such as "Cool White" or "Tropical" at around 20 to 40W will have a colour temperature of 6000° to 6300°K (sunny daylight) which for our purposes is truely white light and this is the only colour temperature that will give adequate reproduction in the BLUE spectrum.

USING STANDARD CCTV BLACK/WHITE CAMERAS FOR TRANSMITTING COLOUR

For our R,G,B, colour transmission we therefore use a black and white camera with a suitable filter carrier in front of the lens. This carrier is fitted up with Kodak Wratten series (or similar) filters, No. 25 for RED, No. 58 for GREEN and No. 47B for BLUE. We illuminate the subject to be transmitted with suitable white light - remembering that it is the colour temperature and not the wattage that is critical (truely a case of quality and not quantity) and we now load our colour information for transmission into the three memories. Exposing the subject through the red filter we snatch it into the red memory, bringing the green filter in front of the lens we snatch into green memory and with the blue filter in front of the lens we snatch into blue memory.

COLOR CORRECTION

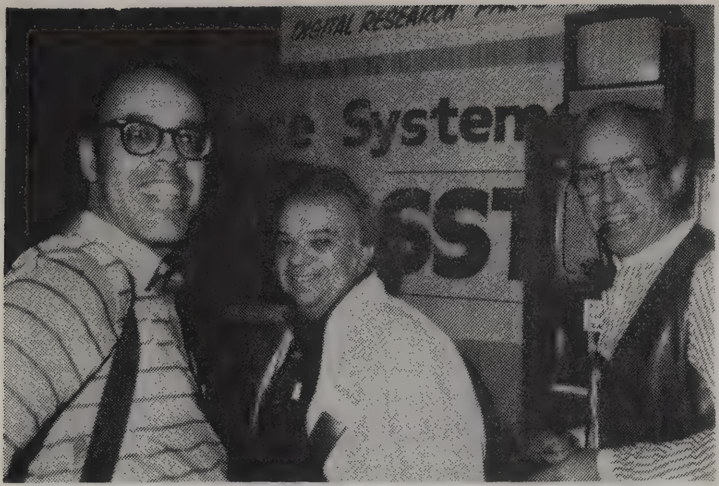
Because the outputs of all three memories are simultaneously driving the three colour guns of our colour monitor, we will see a full colour picture. It is at this stage that we do our colour correction. Assuming that we find our picture is too green - this indicates that we fed in too much information into the green memory. To correct this we put the green filter back in front of the lens, switch to green memory (still in the "HOLD" position) and reducing the snatch brightness control a small increment at a time, we snatch new green information into the green memory by pressing the snatch button after each correction. The green cast will start reducing immediately and if we overcorrect it will swing over into a magenta cast because by removing too much green we accentuated blue and red which makes up magenta. We must therefore turn back the brightness control an increment at a time, while snatching after each increment, until we reach a happy mean between green and magenta, where there should be no cast at all. All three primary colours and all three secondary colours can be either accentuated or reduced by simple addition or subtraction through one or two filters. The accentuation or reduction can also be effected by varying the lens aperture instead of the snatch brightness. Opening the lens is equivalent to increasing snatch brightness and shutting down the lens is equivalent to reducing snatch brightness.

Have fun; See you on the Colour SSTV Airwaves!

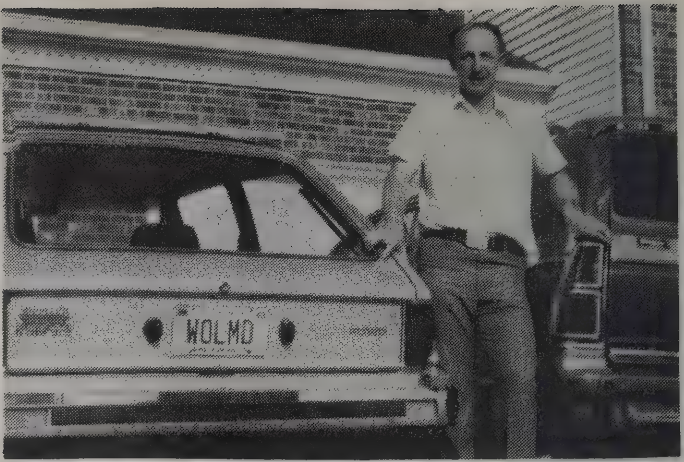
73's - ZS6BTD

Figure 1.

Additive colour synthesis. This system relies on the fact that when a red **R**, a green **G**, and a blue **B** light beam are projected on top of each other the colours are added up. Where all three beams overlap the result is white, where two beams overlap the complementary of the third beam is produced. Thus green and red give yellow **y**, green and blue give cyan **c**, and blue and red give magenta **m**.

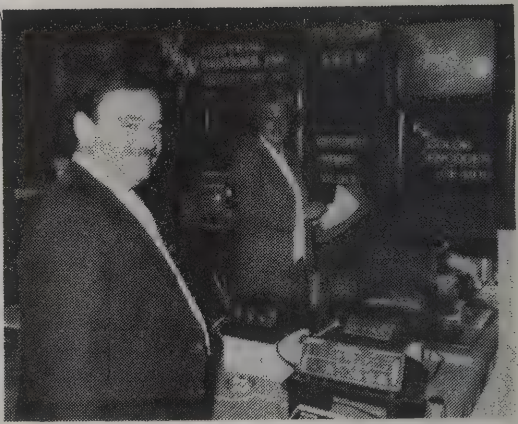


Ron KB8LU, Sam WA7WOD and Tom KB9MC

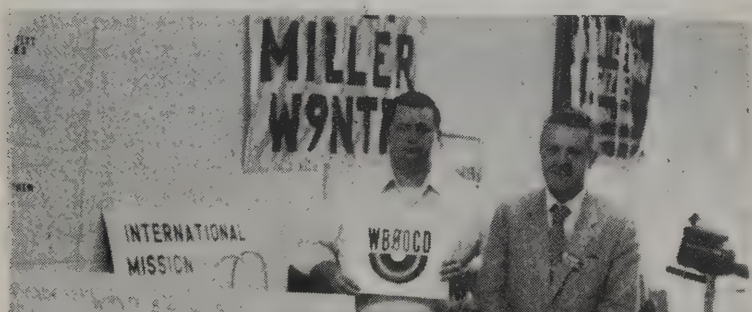


W0LMD Robert Suding

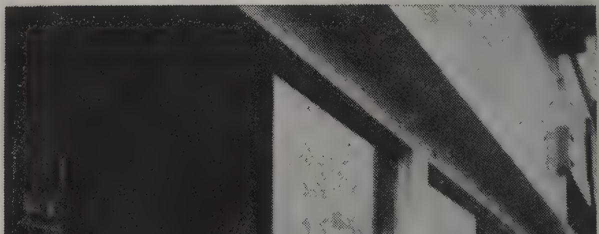
Color SSTV Operator Charlie Chaney KA6CDK, Rowland Hts., CA



Walter and Kate Giesser, KW Systems



Mike Stone, WB0QCD, Don and Sue Miller W9NTP at Peoria, 1982



SSTV Communications harvests long time international DX friendships, KA6BRT John, DJ4GL Joahim (A5 Rep. in Germany and Ham Radio Outlet's KB6TL Ken pose for A5.

SSTV Over Oscar 8 Satellite

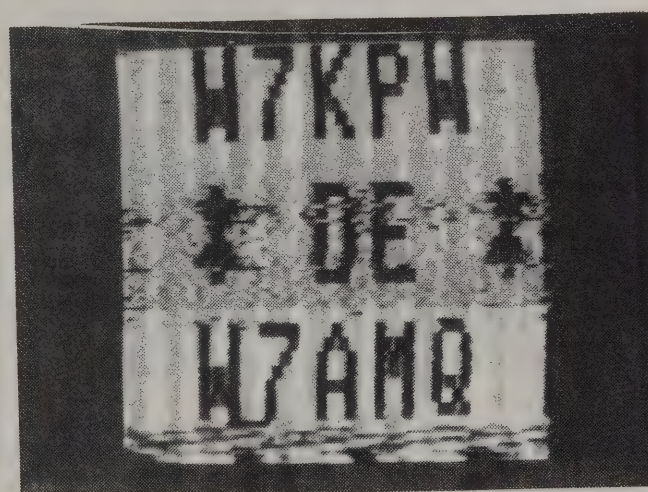
By Gale Sells

7811 N.E. Prescott
Portland, Oregon 97218
(503) 252-8851

I have been active on Oscar 7 and 8 for several years. My first contact over Oscar 7 was in December 1977; this was the same time I became interested in SSTV and purchased the Robot 400 unit. After getting acquainted with SSTV for a couple of years, I got the urge to try SSTV over a satellite though I had not heard any SSTV activity on the satellites up until then. On March 22, 1979 I sent out an SSTV CQ on Oscar 8 mode A orbit 5329. After trying several times over the following month I finally received an answer to my CQ from N7QM, Dwayne, of Prescott, Arizona. He did not have SSTV capability for over the satellite at that time but he told me about Bob W7KPW, who had done some SSTV over the satellite. With the help of Dwayne, Bob, and I made our first contact on May 3, 1979 over Oscar 8 mode A orbit 5914. We were successful in exchanging pictures and since then we have had several good contacts. The pictures enclosed are from our October 16, 1980 QSO over Oscar 8.

It's a real thrill to see your own SSTV returning from the satellit as it is being sent up. It is very difficult to receive a complete picture because of fading caused by the tumbling of the satellit in space. This causes a shift in antenna polarization horizontal to vertical. Fading is also caused by the radio wave traveling thru the ionized region of the ionosphere where the wave rotates in polarization. The receiver must also be constantly tuned to compensate for the doppler effect on frequency. The time available for SSTV communication over Oscar 8 is 15 minutes or less. During the pass the antennas must be made to track the satellite both for azimuth and tilt. The uplink and downlink antenna polarization is critical and must be set and occasionally corrected by sampling the return signal.

After considerable experience I have learned to choose polarization and antenna starting positions ahead of the pass time. The longitude and recent reception conditions helps me make these choices.



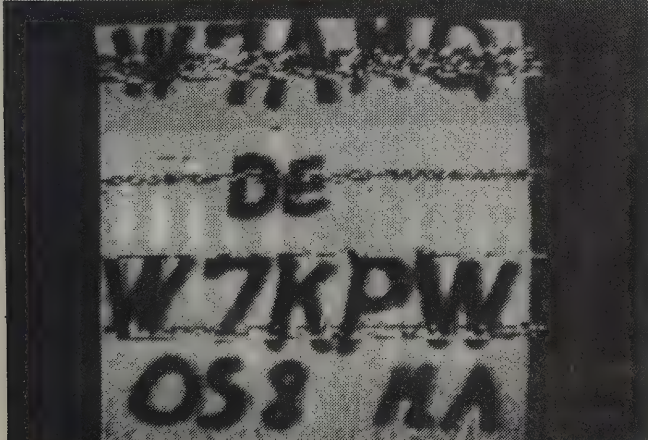
The various magazine publish Oscar operating schedules giving the date, orbit number, time for crossing the equator and longitude. We use either the Oscarlocator or Satellable calculators to determine the timing etc for all the passes after the initial one listed in the schedule. The calculator tells us when the satellite will be in range and illustrates the path also the varying angle of tilt necessary for the antennas.

We are really looking forward to the Phase III satellite which will be sent up in 1982. The access time in the northern hemisphere will be approximately 12 hours; because of this there will be only a gradual change in frequency as caused by the doppler effect.

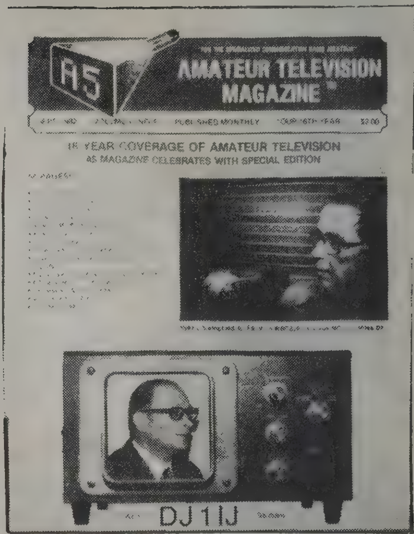
Everyone interested should join AMSAT and also make donations to help them with their satellite programs.

I would appreciate hearins from anyone interested in or now sending SSTV via OSCAR Satellites.

W7AMQ



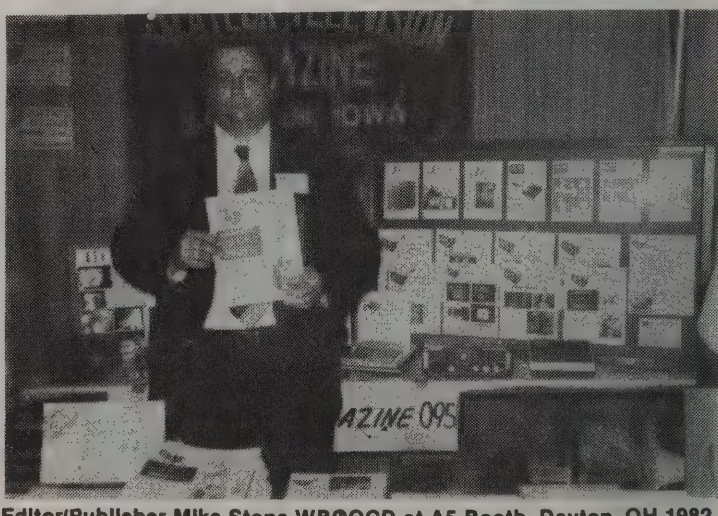
THE HISTORY OF A5 ATV MAGAZINE
16 Years of Devotion to Ham TV
1967 - 1983



As early as the mid-1930's, Amateur's were "experimenting" with various methods of television which eventually led to the commercial standards known today. Although quite crude by today's standards, W2USA Radio Club operated HAM-TV communications at the 1939-40 New York World's Fair on 2.5 and 5 meters with 120 lines of video resolution. Experimentation with the TV mode was sparce until the popularity began to spread in the late 1960's using modified RCA, General Electric and Motorola UHF transceivers. The "T-44" cavity became a sought after video transmitter by 432 Mhz. SSB'ers who began to branch out from UHF voice communications to the more complex visual mode. ATV standards varied from local areas and from state to state making it difficult to find common ground for newcomers. WB2SZW Martin Balk and WB2UMG Donald Le Wine got together in September of 1967 and published "Volume 1, #1" of A5 MAGAZINE, a new 6 times per year publication with over 200 subscribers nationally. Amateur Radio's only Ham TV publication ceased operation shortly during 1971 until republished by K3ZKO Ron Cohen with Volumes 2-3-4 beginning in 1972. The 5" × 8" size periodical was printed by a large VHF Club in the northeast with first advertising supporters of PC Electronics, Denson Electronics, Janel Preamps, ATV Research, Ham Buerger, CCTV Center, SCAL ATV Club, HDL, Spectronics and Hamtronics. Publishment ceased again in March 1974 with WB9WWM Henry Ruh located in Michigan picking up Volume 5 in January 1975 and continuing on for 6½ years through Volume 11 in 1981. A commercial printer was contracted for "professional" printing and subscription services with the first "color" issues printed in an upgraded 8½" × 11" format. Regular column editors were added with international subscriptions numbering now over 1,000. Henry Ruh sold the publication rights of A5 ATV MAGAZINE in June of 1981 to SSTV Column Editor Mike Stone WBØQCD of Lowden, Iowa. The September/October Volume 11-5 issue carried headlines of the new "changeover/ownership" and a "renewed" vow of Ham-TV as it's priority subject matter with an "expanded format" to also include other modes of Amateur Specialized Communications such as NBTV, MSTV, SSTV, FAX, RTTY, EME, Satellite-TVRO, Microwave and Computers. The Volume 12 series saw average page expansion (48), more color covers, new columns and membership services, and a shocking announcement in March 1982 of "monthly" issues. A5 ATV MAGAZINE saw it's first subscription price raise in many years (from $7.50 to $10.00 for 6 issues). The fall "November" issues were declared the annual Color SSTV specials and a major "consistant" cover redesign started with the June Volume 12-6 1982 issue. Subscriptions grew again for the first time in many years to nearly 2,000 members including over 60 foreign country mailings. Printing was moved closer to Davenport, Iowa and a "computer" subscription service was employed to better handle membership services and updating. A revised ATV manual - "Everything You Always Wanted To Know About ATV* but were afraid to ask" was published and sold over 1,000 copies in less than a year. An A5 ATV MAGAZINE sponsored "UNITED STATES ATV SOCIETY" was officially formed in January 1983 with over 1,200 members to give a stronger and more organized political voice relating to Amateur Television mode affairs. Plans for 1983 and beyond include lobbying for protection and expansion of FSTV/SSTV frequencies, mode standards and advancements, space satellite TV repeaters, international ATV group exchanges, etc. A5 ATV MAGAZINE continues to support all modes of specialized Amateur Radio communication and is published by QCD PUBLICATIONS, INC.

UNITED STATES
AMATEUR TELEVISION SOCIETY
DEVOTED TO HAM TV
Founded in 1983

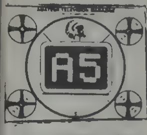
AMATEUR TELEVISION MAGAZINE
Mike Stone, WBØQCD
P.O. Box H, Lowden, Iowa 52255



Editor/Publisher Mike Stone WBØQCD at A5 Booth, Dayton, OH 1982

AMATEUR TELEVISION MAGAZINE
MEMBERSHIP SERVICES DEPARTMENT

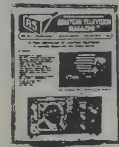
Between 120-150 hours per month go into each "A5" monthly issue before it is delivered to your doorstep. Our "membership services department" additionally offers other ATV subscriber related material. Material may be acquired from "A5 Membership Services Dept., P.O. Box H, Lowden, Iowa 52255-0408. (Return mailers are not required.)



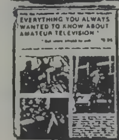
Official A5 FSTV/SSTV "Test Pattern — Printed on 8½ × 11 cardboard stock, this "Indianhead" alignment "test pattern" is great for proper picture centering, resolution testing, camera focus adjustments and has a space provided to insert your own callsign for a unique TV calling card. Pattern may be colored with marker or crayon for color tests. $1.50 ppd.

USATVS "Video Standards P-Chart" — Designed for A5 Magazine by Dave Williams WB0ZJP of St. Louis, Missouri, this 6 picture chart depicts actual snowy to closed-circuit level ATV signals and the proper video signal reporting designation. A must for every ATV shack! Also printed on white cardboard stock and available for $1.50 ppd.

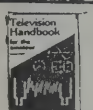
A5 ATV MAGAZINE "Master Article Index File" — 15 years accumulation of "A5" articles listed in categorical order. A "quick" reference guide to all those related specialized communication questions, problems and cures. Available for $1.00 with SASE, $1.50 ppd.



A5 ATV MAGAZINE "Back Issue Copy Service" — Some recent past issues of "A5" are still in stock and available directly from ATV MAGAZINE (see monthly on-hand listings) for $2.50 ppd. Out of print and available "back issues" from Volume 1, #1 are available from Ralph Wilson WB0ESF, 4011 Clearview Drive, Cedar Falls, Iowa 50613. (Volumes 1-8 $1.50 each, 9-11 $2.00, 12-present $2.50 each ppd.) Specialty article "packages" on FSTV, MSTV/NBTV, SSTV, SATV/TVRO, FAX, RTTY, COMPUTERS and ROBOT 400 "Mods" are available for $5.00 ppd. (Send for listing of included articles.) Other magazines, books, manuals, schematics, etc. photocopied on a custom basis. (Foreigners please send extra IRC's to cover Air-Mailing returns).

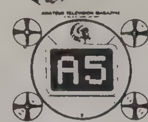


"EVERYTHING YOU ALWAYS WANTED TO KNOW ABOUT ATV" but were afraid to ask" — A5 ATV Manual tells you just about everything you need to know about Amateur Television operation! Over 100 pages loaded with goodies including chapters on FSTV and SSTV (revised 2nd edition March 83), ATV repeater directory, A5 "Master Index" guide and a commercial advertising section. $9.95 plus $2.00 postage/handling.

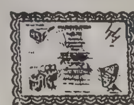


Television Handbook for the Amateur" — 96 pages loaded with serious video technical descriptions, diagrams, charts and photos on television signals by Biago Presti of Aptron Laboratories. A "must" item for any ATV Amateur who wants to go beyond "appliance" operation. $6.00 ppd.

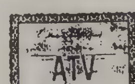
A5 COMPUTER INFORMATION EXCHANGE SERVICE — Via our regular "Computer Corner" columns, A5 coordinates information, modifications, programs for many home-computers such as Apple, TRS80, VIC Commodore, PET, SWTP, Health, Sinclair, Texas Instruments, Z-80 and others as related to ATV functions. We specialize in the Radio Shack TRS80C Color Computer and maintain a working program library of over 200 programs. Send for information.



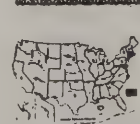
FSTV AWARD — "Getting the Amateur Television Station operating is an award in itself!" This award certificate recognizes the "first" Amateur Television two-way contact. Endorsements for DX mileage and COLOR ATV available. Contacts via Amateur ATV Repeaters is allowed. Award inscriptions are made around the border of the A5 block. Black/White 8 × 10".



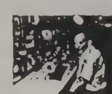
SPECIALIZED COMMUNICATIONS AWARD — A5 Magazine recognizes and supports all modes of Amateur Specialized Communications. This award recognizes accomplishments in ATV-MSTV -NBTV - SSTV - FAX -RTTY - EME - MICROWAVE and SATELLITES. Entry levels are contacts over 50 mi. on ATV, Special-event ATV projects, 25 DX Country contacts on SSTV, reception of HF MSTV or FAX signals via Amateurs, Microwave DX, 10 DX Foreign countries via EME, 10 two-way contacts on an Amateur Satellite, 25 DX Countries on RTTY with special endorsements available for additional contacts. Certificates are numbered as received, Gold 8 × 10" suitable for framing.



A5 MASTER SCANNER CERTIFICATE — This award recognizes the serious SSTV'er. Entry level is 100 two-way SSTV contacts. Endorsements for 500,1000, 1500, 2000 etc. available. Special endorsement for COLOR SSTV available with verified print copy. A must for every SSTV'er! Gold 8 × 10".



A5 W.A.S. SSTV/RTTY AWARD — A5 ATV Magazine sponsors the annual January WAS/SSTV Contest. Work all 50 states including Hawaii and Alaska with exchange of callsign and signal report in video. A special WAS Map is available to color in the states as you get them. Special endorsements available for multi-band WAS.



DAYTON "GOOD IMAGE" AWARDS — Awarded at the Dayton Hamvention each year, the Good Image award is presented to the individual or group of individuals who contributed to the advancement of the A5 mode of communication by technical achievement or public awareness. Top of the line award! A special "SSTV'er of the Year" award is announced in the November annual color issue.

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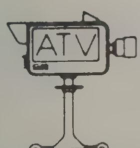

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"Official Journal of the USATVS"

A5

INTERNATIONAL

AMATEUR TELEVISION MAGAZINE

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A5 ADVISORY/TECHNICAL REVIEW/CONTRIBUTING EDITOR STAFF

CUMULATIVE INDEX FOR AMATEUR TELEVISION MAGAZINE 1967-1983
A GUIDE TO OVER 1300 ARTICLES, PROJECTS AND ITEMS

ATV LINEARS

ATV POWER AMPS

EDITORIALS

EXPERIMENTAL MODES: MEDIUM SCAN, SAMPLE DOT, NARROWBAND

FAX, SATELLITE, EME, OTHER

MEASUREMENT AND TEST EQUIPMENT

MICROWAVES

PUBLIC RELATIONS AND PUBLIC SERVICE

RADIOTELETYPE (RTTY)

REVIEWS AND TEST REPORTS

RF PREAMPS

SLOW SCAN TELEVISION

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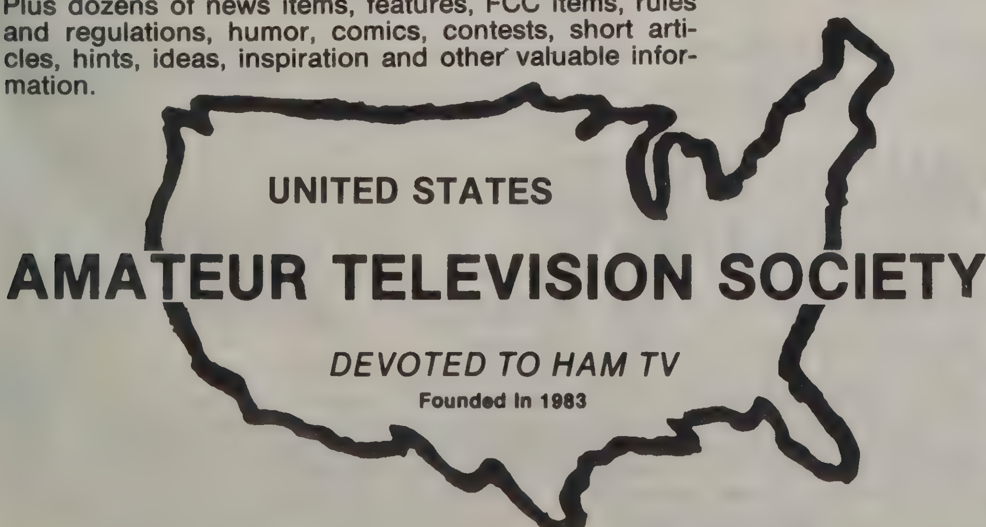

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ATV Converter*

Convert any TV receiver to a fast scan ATV monitor without incurring the expense of commercially made equipment. The Communication Concepts Inc. converter allows you to monitor 430MHz ATV signals using channel 3 or 4 on a standard TV set, without modification to the set. The kit consists of a low noise high gain RF amplifier (MRF-901), a double balanced mixer and a Varicap® controlled local oscillator. By using Varicap diode tuning, the converter can be placed directly at the receiving antenna and tuned remotely with a standard 10K potentiometer, if desired. This technique greatly increases the signal strength at the TV receiver by reducing the capacitive loss normally encountered when using high frequency signals on coax lines.

The converter requires an external 12 volt regulated power supply at 40 milliamps. For optimum performance, the converter should be mounted in a metal enclosure; thereby providing an RF shield.

ATV-1-PK Kit includes detailed step-by-step instructions, printed circuit board, and all electronic components as shown.
ATV-1-PCB Printed circuit board only $10.00
ATV-1-I Instruction manual only $5.00

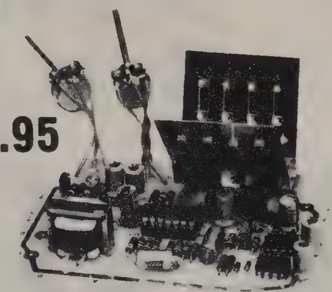
***CIRCUIT BOARD DESIGN LICENSE AUTHORIZED FROM P.C. ELECTRONICS, ARCADIA, CALIFORNIA, 91006**

Audio Squelch Control

You have a squelch on your 2 meter equipment; why not add a squelch to your ATV monitor. Now you can avoid the major problem of operating ATV—the annoying hiss and static when the signal is not present. With the ATV squelch, you no longer have to turn the volume down when the signal disappears and risk the chance of missing a signal.

The squelch easily connects to the TV receiver audio stage without modification of the TV, since the squelch circuit contains its own audio output stage. You must provide your own speaker. Operator safety is provided by using transformer isolation between the receiver and the squelch circuit, thus eliminating the shock hazard when using a "hot chassis" type TV receiver.

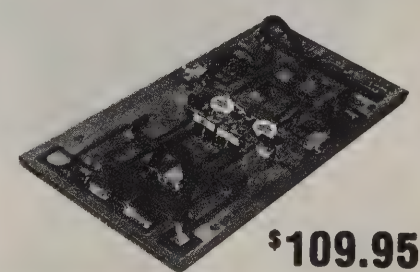
$34.95



SIL-K Complete Kit—includes a detailed instruction manual, printed circuit board and all electrical components. Kit does not include case, speaker and regulated power supply (10 to 15 volts @ 250mA).
SIL-PCB Printed circuit board only **$10.00**

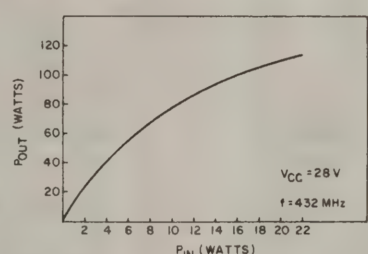
100 Watt Linear Amplifier

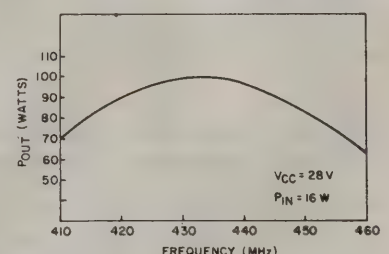
Now you can get on the air with a high power 100 watt class B linear amplifier for SSB-FM or ATV on the 420 to 450 MHz band and still not spend a lot. This kit is described in Motorola engineering bulletin EB-67 and is available in a number of configurations. For full output, a minimum of 16 watts is required for excitation with an input SWR of not higher than 2:1. Output will maintain stability with a 3:1 collector mismatch at all phase angles. A designed-in low-pass filter suppresses the 2nd harmonic to at least 63 dB down. An external power supply capable of providing 28 VDC, regulated, at 10 amps is also required.



$109.95

KEB-67-PK Kit includes detailed step-by-step instructions, printed circuit board, and all electronic components as shown.
KEB-67-PCB Printed circuit board only $14.
KEB-67-I Instruction manual only $5.00





P.C. Boards

The FCC does not allow us to sell Broadband RF amplifier kits in the HF range, therefore we can only offer the printed circuit board and parts on a piece-by-piece basis.

140 watt power amplifier as described in Motorola engineering bulletin EB-63. **EB-63-PCB**

100-180 watt power amplifier as described in Motorola application note, AN-762. **AN-762 PCB**

300 watt power amplifier as described in Motorola engineering bulletin EB-27A. **EB-27A PCB**

Transformers, transistors and other parts are also available.

We also specialize in hard-to-find components.

In addition to our kits, we also stock parts for other Motorola application notes and engineering bulletins. We have an in-depth stock of Motorola VHF and UHF transistors, Underwood metal clad mica capacitors (Unelco), Kemet chip capacitors, Cambion RF chokes and Ferroxcube Ferrite beads and RF chokes plus other difficult to find parts. If you are having trouble finding a part, call us, we probably have it in stock.

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TC-1

Connect to the ant. terminals of any TV set, add a good 450 antenna, a camera, and you are there . . . Show the shack, home movies, computer games, etc.

FEATURES

- 10 WATT PEP OUTPUT ON SYNC. DC RESTORED MODULATOR. ADJUSTABLE SYNC. EXPANDER.
- STANDARD FREQ. AVAILABLE: 439.25, 434.0, AND 426.25 MHZ SPECIFY XMTR FREQ. AND DOWN-CONVERTER OUTPUT ON CHANNEL 2, 3, OR 4.
- BROADCAST STANDARD 4.5 MHZ SUBCARRIER SOUND WITH HIGHGAIN MIC & VCR LINE MIXER.
- 8 MHZ BANDWITH MODULATOR FOR HIGH RESOLUTION VIDEO, COLOR, AND COMPUTER ALPHANUMERICS.
- BUILT-IN REGULATED AC POWER SUPPLY.
- TUNEABLE DOWNCOVERTER COVERS 420 to 450 MHZ. CONTAINS LOW NOISE .9db NE64535 PREAMP, PLUS HOT CARRIER DOUBLE BALANCED MIXER.
- TRANSMIT DETECTED VIDEO MONITOR OUTPUT FOR SEEING YOUR OWN CAMERA SETUP.
- SMALL 10.5x3x9. CONTINUOUS DUTY TRANSMITTER.

ACCESSORIES:

48 element J Beam antenna .... $79.95 + ship.
450 Isopole omni antenna .... $65 ppd
Saxton 8285 low loss coax, 100′ .... $41 ppd

OPTIONS

- TWO FREQUENCY EXCITER INSTALLED WITH XTALS ON 439.25 OR 434.0 AND 426.25 mHz, STANDARD. OTHER FREQ. TO ORDER. (NOT AVAILABLE WITH CA-1) **$30**
- PROVISION FOR EXTERNAL 12 TO 14 VDC FOR MOBILE OR PORTABLE **$30**
- MIRAGE D1010 LINEAR AMP W/"N" CONN . . .**$299**
- MATCHED TO DRIVE MIRAGE D1010 AMP WITH SYNC STRETCHER IN TXA5 ADJUSTED FOR 90 WATTS PEP WHEN PURCHASED TOGETHER **$20**
- ON CARRIER AUDIO MODULE CA–1 INSTALLED FOR THOSE AREAS THAT DO NOT USE STANDARD SUBCARRIER OR TWO METERS FOR AUDIO . . . **$50**
  CA-1 MODULE KIT FOR LATER ADD ON **$40**

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★ IF YOU WISH TO BUILD YOUR OWN SYSTEM, SEE THE BASIC 4 MODULE PACKAGE. THE TC-1 CONTAINS THE TXA5, PA5, FMA5, TVC-2L, & DM-1 MODULE FUNCTIONS.

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Hitachi HV62 B & W TV camera .... $199 ppd
Hitachi GP41D color TV camera .... $449 ppd

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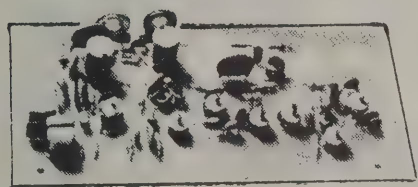
The Basic Four Modules



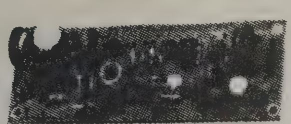
1. TXA5-4 ATV EXCITER/MODULATOR .... **$89 ppd**

This wired and tested module is designed to provide 80 mw drive to the PA5 10 watt linear amp. The crystal in the 100 mHz region keeps harmonics out of two meters for talk back. The video modulator is full 8 mHz for computer graphics and color. Requires 13.8 vdc reg @ 70 ma. Tuned with xtal on 439.25, 434.0, or 426.25 mHz. Built in sync expander.

Two Frequency Exciter .... **$115 ppd**

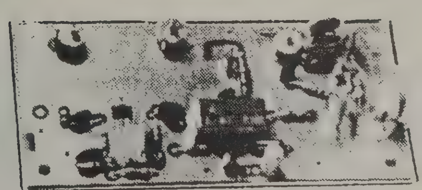
2. PA5 10 WATT ATV POWER MODULE .... **$89 ppd**

The PA5 will put out 10 watts RMS power on the sync tips when driven with 80 mw by the TXA5 exciter. 50 ohms in and out, plus bandwidth for the whole band with good linearity for color and sound. Requires 13.8 vdc regulated @ 3 amps.



3. FMA5 AUDIO SUBCARRIER GENERATOR ..... **$29 ppd**

Puts audio on with your camera video just as broadcast TV does at 4.5 mHz. Puts out up to 1 v p-p to drive the TXA5 or VM-2 or 4 modulators. Requires low Z mic (150 to 600 ohms), or camera or VCR line audio and +13.8 vdc @ 25 ma. Works with any xmtr with 5 mHz video bandwidth.



4. TVC-2 ATV DOWNCONVERTER .... **$55 ppd**

Stripline MRF901 (1.7 db NF) preamp and double balanced mixer module digs out the weak ones but resists intermods and overload. Connect between uhf antenna and TV set tuned to channel 2 or 3. Varicap tunes 420 to 450 mHz. Requires +12 to 18 vdc @ 20 ma.

More sensitive TVC-2L with NE64535 preamp (.9db NF) stage .... **$69 ppd**

NEW *Most sensitive TVC-2G GaAaFet (.5db NF) stage **$79**
Designed for antenna mounting.

TVC-4 ATV DOWNCONVERTER .... **$89 ppd**

This is a packaged version of the TVC-2 converter with built in AC power supply. Has BNC antenna input and F connector TV output.

Also available with the NE64535 (TVC-4L) ..... **$105 ppd**

Size: 5 1/4 X 2½ X 7 inches.

Package Specials

TXA5, PA5, FMA5, and TVC basic module package ..... (Reg. $262) **$249 delivered**

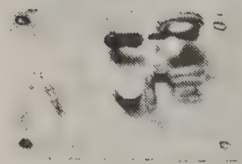
OPTIONS:
- 2 frequency exciter .... add **$26**
- TVC-2L ... .add **$14**   TVC-2G ... add **$24***
- Packaged TVC-4 downconverter .... add **$34**
- Magnacraft W120X-14 coax relay .... add **$41**

*Attention Clubs and Groups ... 10% discount on 5 or more of one module ordered at one time to one address. 2-83

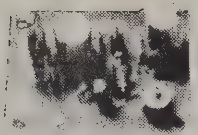
D1010

MML432-50

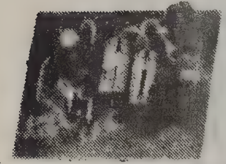
DM-1



TVG-1



TVG-12



VM-3

VM-2

VM-4

D1010-N MIRAGE ALL MODE 100 WATT AMPLIFIER. . . . $299ppd
420 to 450 mHz, FM, SSB, CW, and ATV. Up to 90 watts pep on ATV with only 4 watts drive. Req. 13.8 vdc reg. at 20 amps. Uses "N" connectors. 12" x 3" x 5½". Specially modified by us for ATV.

MML432-50 MICROMODULES 50 WATT AMPLIFIER. . . $269.95
+ UPS
All modes, builtin low noise preamp, 5 in/40 pep out on ATV. Req. 13.8 vdc reg. at 8 amps. BNC connectors. 11" x 5" x 2.2". Charge card or COD only on this unit. Requires sync stretcher added to TXA5 Exciter.

DM-1 RF/VIDEO DETECTOR & MONITOR. . . . . $20ppd.
Samples RF off xmtr coax and outputs 1 v p-p video to monitor your own camera and setup. Also outputs to a external 50 uA meter for relative power. Req. +12 to 18 vdc at 25 ma. PC board only . . . . $ 5ppd.

TVG-1, TVG-12, $15ppd & TVG-23 ATV TEST GEN. . . . $20ppd ea.
Connect your camera and you have about one milliwatt on the air for demos, ant tests, or receiver alignment. Req. 9vdc at 7 ma. TVG-1 tunes 400-480 mHz, TVG-12 tunes 1200-1300 mHz, and TVG-23 setable 2.1-2.5 gHz.

TSQ-1 TV S-METER AND SQUELCH BOARD $5ppd
Add common or Radio Shack parts, tap into TVs video IF AGC line, break one speaker lead, and you can better align the antenna, give relative signal reports, and have no noise between contacts.

VM-2 TUBE TYPE XMTR MODULATOR. $20ppd
Grid modulates tetrodes:5894, 6907, 6524, and high power 4X250s (K2RIW) & 8930s. Req. extra 2N3738 for high power. $5

VM-3 1 WATT TRANSISTOR XMTR MODULATOR $20ppd
For VHF Eng., Hamtronics, GLB, etc. transitor exciters. SS-1 SYNC EXPANDER for driving high power transistor amps . . . . $17ppd.

VM-4 2C39 TRIODE CATHODE MODULATOR $25ppd
Get full color and sound on 400 & 1200 mHz amps.

REPLACEMENT PARTS AND ACCESORIES

MRF901	10 for $20	Bare PC boards	at $5 ea:
NE64535	2 for $25	TSQ, VM-2,3,&4,DM-1,VA-2,PA5,TCPA,TD-1	
2N3738	2 for $10	TXA5 exciter crystals	$15
2N6424	2 for $10	Magnacraft W120X-14 T/R relay	$41
LM350 3 Amp regulator	$10	CX-600N .5Kw type N coax relays	$65

All our manufactured modules can be serviced by us for $15 plus parts cost. TC-1s are $30 plus parts. Call or write for return authorization or repair assistance.

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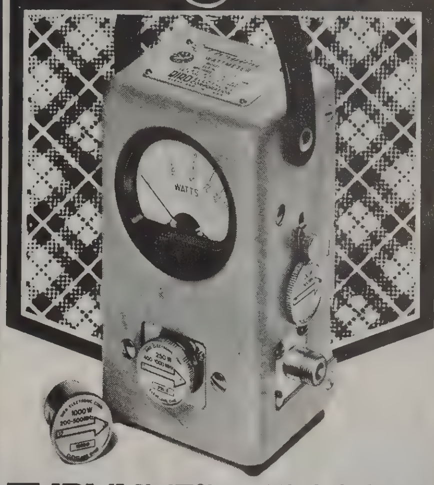

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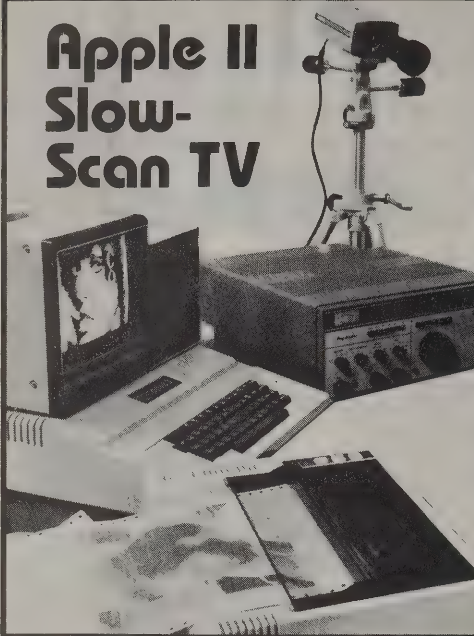

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P50VD	50-54	<1.3	15	0	DGFET	$29.95
P50VDG	50-54	<0.5	24	+12	GaAsFET	$79.95
P144VD	144-148	<1.5	15	0	DGFET	$29.95
P144VDA	144-148	<1.0	15	0	DGFET	$37.95
P144VDG	144-148	<0.5	24	+12	GaAsFE	$79.95
P220VD	220-225	<1.8	15	0	DGFET	$29.95
P220VDA	220-225	<1.2	15	0	DGFET	$37.95
P220VDG	220-225	<0.5	20	+12	GaAsFET	$79.95
P432VD	420-450	<1.8	15	−20	Bipolar	$32.95
P432VDA	420-450	<1.1	17	−20	Bipolar	$49.95
P432VDG	420-450	<0.5	16	+12	GaAsFET	$79.95

Preamps are available without case and connectors: subtract $10. Other preamps available in the 1 - 800 MHz range. Prices shown are postpaid for U.S. and Canada. CT residents add 7-½% sales tax. C.O.D. orders add $2. Air mail to foreign countries add 10%.

Advanced Receiver Research

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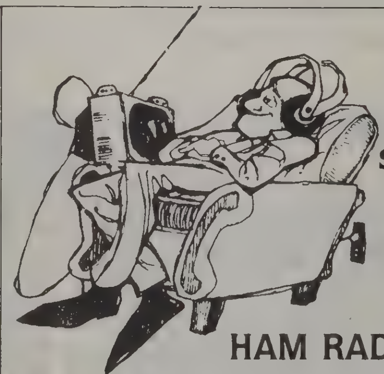

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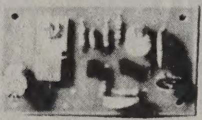
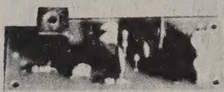
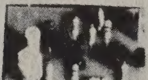
ATV KITS AND MODULES



VM-2 **VIDEO MODULATOR** — Wideband collector video modulator for solid state exciters such as those from GLB and Hamtronics. Input for 4.5MHZ audio sub-carrier. 2½" x 1½"; **$13.95** kit, **$18.95** assembled.

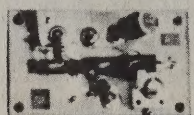


A-2 **4.5MHZ AUDIO SUB-CARRIER** — Accepts audio from VCR or GLB audio processor to provide ATV audio on TV set. Has on-board voltage regulator and shielded inductor. 2 3/4" x 1"; **$18.95** kit, **$24.95** assembled.

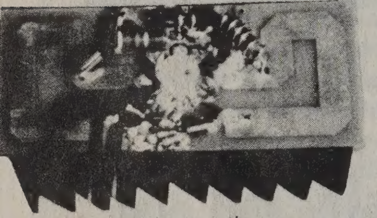


SA-1 **VIDEO SYNC AMP** — Provides separate video sync gain control for VM-2 above or SE-1a transceiver. Useful when driving solid state amps. 1 3/4" x 1 1/4"; **$14.95** assembled, **$11.95** kit.

DC—1 **UHF CONVERTOR** — Varactor tuned with 2 RF stages. MRF901 input standard. Double sided stripline design. Outputs to TV ch. 2, 3 or 4. Can be tower mounted. 11 — 14vdc. 2" x 3". $34.95 kit, **$49.95**, assembled, **$79.95** complete in box. Add **$15.00** for NE64535 1st stage.



P-1 **WIDEBAND LOW NOISE UHF PREAMP** — Uses MRF901 transistor to provide 16db gain and 1.7db noise figure. Covers 420—450MHZ band. Other frequencies received with change in input inductor. 2 1/4" x 1 3/8"; **$17.95** kit, **$26.95** assembled. Add $15.00 for NE64535 Option.



LA-1 **UHF AMPLIFIER** — Uses 15 watt MRF641 transistor with 7.8db gain @ 470MHZ. Stripline inductors with on-board pin diode antenna switching for a receiver. Designed for wideband color video with exciters such as the GLB T450L that provides up to 3 watts drive. Drilled and tapped heatsink included (4 1/2" x 1 3/4"). 1 to 3 watts drive typically gives 6 to 18 watts output. 12 — 14vdc operation @ 4 amps max. Double-sided board is 4 ½" x 2". **$69.95** assembled with test data.

LA—45 UHF AMPLIFIER — Uses MRF646. Input power of 6-15 watts typ. gives 20-50 watts output. Biased for linear operation. Kit includes all parts, instructions and 4.2" x 3" double-sided stripline board. Needs 12-14 vdc @ 9 amps max. **$59.95** kit.

GLB T450L TRANSMITTER — 4 1/2" x 2" RF board typically supplies 2—3 watts FM output, 1 — 1½ watts average video RF output. Changes for wideband video modulation provided. Comes with crystal for 439.25MHZ, with other frequencies available upon request. Also includes separate 1" x 4" audio processor board which supplies audio for FM modulation or for the A—2 4.5MHZ audio kit above. 12—14vdc @ 2 amps max. **$54.95** kit, **$74.95** assembled and tuned.

COMMON TO ALL KITS AND MODULES — 12 to 14 vdc operation. Drilled and plated glass circuit boards. Quality components with instructions including schematic and board layout.

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